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## CONTENTS OF VOLUME XXXI

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THE NINETY-SEVENTH ANNUAL MEETING: MINUTES, 181; PROGRAM, 173; PAPERS . . . . .	1-124, 273, 295, 327, 457, 481, 496, 549, 690
ARTICLES AND NOTES . . . . .	1, 245, 457, 653
REVIEWS . . . . .	212, 417, 608, 757
CHAPTER ACTIVITIES. . . . .	144, 391, 563, 739
STATISTICAL NEWS AND NOTES . . . . .	153, 397, 578, 740
NEW MEMBERS . . . . .	169, 415, 605, 755
REPORTS AND OFFICIAL NOTICES . . . . .	186, 390
CORRECTIONS . . . . .	126, 391, 562

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## ARTICLES AND NOTES

A Coöperative Arrangement for General Relief Statistics . . . . .	736
ANDREWS, F. E. Letter to the Editor . . . . .	561
BARTLETT, M. S. Statistical Probability . . . . .	553
BEAN, LOUIS H. Discussion of "The A.A.A., the Cotton Growers, and the Agricultural Problem" . . . . .	308
BELCHER, DONALD R. Malcolm Churchill Rorty. . . . .	603
BERKSON, JOSEPH. A Test for the Goodness of Fit of a Curve Graduated to a Series of Observed Means . . . . .	723
BOWERS, GLENN A. Setting Up State Administration for Unemployment Insurance . . . . .	67
BOWLEY, A. L. The Application of Sampling to Economic and Sociological Problems . . . . .	474
BRAND, CHARLES J. Legal Aspects of Statistical Activities of Trade Asso- ciations with Special Reference to the Sugar Institute Decision . . .	367
BRAND, CHARLES J. The Statistical Work of The National Fertilizer Asso- ciation . . . . .	552
Central Statistical Board, Organization of . . . . .	386
COHEN, MORRIS R. The Statistical View of Nature . . . . .	327
Conference on National Income and Wealth . . . . .	130

Coöperative Research on Prices . . . . .	128
COPELAND, MORRIS A. Discussion of "Changes in the Wholesale Price Index in Relation to Factory Employment" . . . . .	503
COX, A. B. The A.A.A., the Cotton Growers, and the Agricultural Problem . . . . .	295
Rejoinder . . . . .	314
DEDRICK, CALVERT L. Progress of Work in the Census Bureau . . . . .	737
DEMING, W. EDWARDS. The Present Interests of Physicists in Statistics . . . . .	124
DENSEN, PAUL M. Price Stability and Responsiveness to Changes in the Price of Gold . . . . .	85
DUBRUL, S. M. A Proposal for an Integrated Program for the Reporting of Business Statistics to Government Agencies . . . . .	53
DUCASSE, C. J. Discussion of "The Meaning of Probability" . . . . .	29
DUCASSE, C. J. Discussion of "The Statistical View of Nature" . . . . .	347
DUNN, HALBERT L. The Evaluation of the Effect upon Mortality Statistics of the Selection of the Primary Cause of Death . . . . .	113
EDWARDS, ALBA M. The Negro as a Factor in the Nation's Labor Force . . . . .	529
EVANS, GEORGE HEBERTON. The Index Numbers, A.M. <sub>I</sub> and A.M. <sub>II</sub> . . . . .	726
FERGER, WIRTH F. Distinctive Concepts of Price and Purchasing-Power Index Numbers . . . . .	258
FISHER, IRVING. Changes in the Wholesale Price Index in Relation to Factory Employment . . . . .	496
Rejoinder . . . . .	505
FOX, MORTIMER J., JR. Deposit Insurance as an Influence for Stabilizing the Banking Structure . . . . .	103
FOX, MORTIMER J., JR. A Broadened Program of Bank Reports . . . . .	549
FRIEDMAN, MILTON, see Kneeland, Hildegarde	
GIRSHICK, M. A. Principal Components . . . . .	519
GOLDENWEISER, E. A. Significance of the Lending Function of the Federal Reserve Banks . . . . .	95
GOSNELL, HAROLD F., and SCHMIDT, MARGARET J. Factorial and Correlational Analysis of the 1934 Vote in Chicago . . . . .	507
GOURRICH, PAUL P. Statistics Relating to Security Markets and Corporations . . . . .	88
Graphic Presentation . . . . .	560
HAAS, GEORGE C. Special Studies on Statistics of Income . . . . .	132
HALLIGAN, C. W. The Practical Side of Trade Association Statistics . . . . .	491
HARBESON, ROBERT W. Index Numbers and Public Utility Valuation . . . . .	245
HAYFORD, F. LESLIE. Some Uses of Statistics in Executive Control . . . . .	31
HILL, J. A. Progress of Work in the Census Bureau. . . . .	141, 387, 558
Institute of Mathematical Statistics . . . . .	128
JOHNSON, NORRIS O. A Trend Line for Growth Series, Further Remarks . . . . .	731
KENNEDY, S. J. Industry Statistics in Marketing Management . . . . .	702
KING, WILLFORD I. Consolidating Our Gains. . . . .	1
KING, WILLFORD I. Edgar Sydenstricker . . . . .	411
KNEELAND, HILDEGARDE, SCHOENBERG, ERIKA H., and FRIEDMAN, MILTON. Plans for a Study of the Consumption of Goods and Services by American Families. . . . .	135
KUVIN, LEONARD. Effect of N.R.A. on the Physical Volume of Production . . . . .	58
LEONG, Y. S. Statistics on Copper in the United States . . . . .	665
LOTKA, ALFRED J. The Geographic Distribution of Intrinsic Natural In-	

crease in the United States, and an Examination of the Relation between Several Measures of Net Reproductivity . . . . .	273
MALZBERG, BENJAMIN. Rates of Mental Disease Among Certain Popula- tion Groups in New York State . . . . .	545
MARGENAU, HENRY. Discussion of "The Meaning of Probability" . . .	27
METHORST, H. W. The New System of Population Accounting in the Netherlands . . . . .	719
MUENCH, HUGO. The Probability Distribution of Protection Test Results.	677
NAGEL, ERNEST. The Meaning of Probability . . . . .	10
NEYMAN, J., and TOKARSKA, B. Errors of the Second Kind in Testing "Student's" Hypothesis . . . . .	318
Occupational Dictionary . . . . .	389
PEARL, RAYMOND. Karl Pearson, 1857-1936 . . . . .	653
PEARSON, EGON S. Statistical Method and Industry in Great Britain. .	361
PERLMAN, JACOB. Training Field Agents in the Bureau of Labor Statistics .	735
RAYMOND, FAIRFIELD E. Bases of Control for Industrial Operation . .	37
ROBINSON, LELAND REX. Corporate Earnings on Share and Borrowed Capital in Ratios of Gross Income (1918-1935) . . . . .	481
RORTY, M. C. Unemployment Insurance and Unemployment . . . .	61
SANDERS, BARKEY S. The Purpose and Progress of the Attorney General's Survey of Release Procedures . . . . .	732
SCHMIDT, MARGARET J., see Gosnell, Harold F.	
SCHOENBERG, ERIKA H., see Kneeland, Hildegard	
SISSMAN, LOUISE. Development of the Postal Savings System . . . .	708
SNEDECOR, GEORGE W. The Improvement of Statistical Techniques in Biology . . . . .	690
STOUFFER, SAMUEL A. Evaluating the Effect of Inadequately Measured Variables in Partial Correlation Analysis . . . . .	348
THOMAS, DOROTHY SWAINE. The Swedish Census of 1935-6 . . . .	541
THORP, WILLARD L. Wanted—Industrial Statistics . . . . .	47
TITUS, WALTER F. The Kind of Information an Executive Needs to Oper- ate a Factory . . . . .	43
TOKARSKA, B., see Neyman, J.	
TUCKER, RUFUS S. Real Wages of Artisans in London, 1729-1935 . .	73
TURNER, A. WILLARD. Note on An Index of Bond Prices . . . . .	555
WALLIS, W. ALLEN. The Poisson Distribution and the Supreme Court .	376
WAUGH, FREDERICK V. The Analysis of Regression in Subsets of Variables.	729
WHELPTON, P. K. An Empirical Method of Calculating Future Population	457
WILKS, S. S. Discussion of "The Meaning of Probability" . . . . .	29
WISHART, JOHN. Statistics in Chinese Agricultural Research . . . .	127
WÜRZBURGER, EUGEN. On the Comparability of Death Rates . . . .	381

## REVIEWS

ABRAMSON, VICTOR. See Lyon, Leverett S.	
ADAMS, ARTHUR B. <i>National Economic Security</i> . Frederic Dewhurst . .	785
ADARKAR, BHALCHANDRA P. <i>The Theory of Monetary Policy</i> . Eleanor Lansing Dulles . . . . .	633
ALDERFER EVAN BENNER. <i>Earnings of Skilled Workers in a Manufactur- ing Enterprise 1878-1930</i> . Jacob J. Blair . . . . .	441

ALLEN, R. G. D. and BOWLEY, A. L. <i>Family Expenditure: A Study of Its Variations</i> . Faith M. Williams . . . . .	610
ALLEN, R. G. D. and BOWLEY, A. L. <i>Family Expenditure: A Study of Its Variation</i> . Henry Schultz . . . . .	613
ANDERSON, OSKAR N. <i>Einführung in die mathematische Statistik</i> . A. R. Crathorne . . . . .	417
ANDREWS, F. EMERSON. <i>New Numbers</i> . W. V. Lovitt . . . . .	425
ARKIN, HERBERT and COLTON, RAYMOND R. <i>Graphs—How to Make and Use Them</i> . Frederick E. Croxton . . . . .	625
BAKEWELL, PAUL. <i>Past and Present Facts about Money in the United States</i> . W. A. Morton . . . . .	802
BAKKE, E. WIGHT. <i>Insurance or Dole? The Adjustment of Unemployment Insurance to Economic and Social Facts in Great Britain</i> . Bryce M. Stewart . . . . .	646
BALDERSTON, C. CANBY. <i>Executive Guidance of Industrial Relations, An Analysis of the Experience of Twenty-Five Companies</i> . H. F. Browne . . . . .	650
BEACH, W. EDWARDS. <i>British International Gold Movements and Banking Policy, 1881-1913</i> . Melchior Palyi . . . . .	783
BEST, HARRY. <i>Blindness and the Blind in the United States</i> . Evelyn C. McKay . . . . .	230
BEZANSON, ANNE, GRAY, ROBERT D. and HUSSEY, MIRIAM. <i>Prices in Colonial Pennsylvania</i> . R. S. Tucker . . . . .	430
BLAISDELL, WILLIAM M. <i>Financing Security Trading</i> . Jules I. Bogen . . . . .	809
BLODGETT, RALPH H. <i>Cyclical Fluctuations in Commodity Stocks</i> . M. A. Brumbaugh . . . . .	238
BORDEN, NEIL H. and LOVEKIN, OSGOOD S. <i>A Test of the Consumer Jury Method of Ranking Advertisements</i> . Lawrence C. Lockley . . . . .	449
BOWLEY, A. L. See Allen, R. G. D.	
BOYD, EDITH. <i>The Growth of the Surface Area of the Human Body</i> . Eugene F. Du Bois . . . . .	765
BREMER, C. D. <i>American Bank Failures</i> . Wilbert G. Fritz . . . . .	446
BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. <i>Mathematical Tables</i> , Volume V. John D. Elder . . . . .	760
BRITISH ASSOCIATION RESEARCH COMMITTEE. <i>Britain in Depression, A Record of British Industries since 1929</i> . H. Gordon Hayes . . . . .	642
BROWN, THEODORE HENRY. <i>The Use of Statistical Techniques in Certain Problems of Market Research</i> . Charles F. Roos . . . . .	420
BUCK, A. E. <i>The Budget in Governments of Today</i> . Carl Shoup . . . . .	453
BUREAU OF FOREIGN AND DOMESTIC COMMERCE, U. S. DEPARTMENT OF COMMERCE. <i>Consumer Market Data Handbook: 1936</i> . Paul W. Stewart . . . . .	788
BURNS, ARTHUR ROBERT. <i>The Decline of Competition</i> . L. A. Morrison . . . . .	776
BUSSING, IRVIN. <i>Public Utility Regulation and the So-Called Sliding Scale</i> . Edward S. Mason . . . . .	641
CASSEL, GUSTAV. <i>On Quantitative Thinking in Economics</i> . Charles F. Roos . . . . .	627
CASSEL, GUSTAV. <i>The Downfall of the Gold Standard</i> . G. F. Warren . . . . .	803
CHAPMAN, HERMAN HOLLIS. <i>Iron and Steel Companies in Years of Prosperity and Depression</i> . Paul L. Howell . . . . .	809
CHAPMAN, JOHN M. See Willis, H. Parker	
COLE, ARTHUR H. See Smith, Walter B.	

COLTON, RAYMOND R. See Arkin, Herbert.	
COVER, JOHN H. <i>Retail Price Behavior</i> . A. W. Zelomek . . . . .	239
CRUM, WILLIAM LEONARD. <i>The Distribution of Wealth: A Factual Survey Based upon Federal Estate-Tax Returns</i> . Ralph C. Epstein . . . . .	770
DANYSZ, E. S. <i>Contribution à l'étude des fortunes privées d'après les déclarations de succession</i> . W. L. Crum . . . . .	767
DAVIE, MAURICE R. <i>World Immigration, with Special Reference to the United States</i> . Joseph M. Gillman . . . . .	789
DAVIS, HAROLD T. and NELSON, W. F. C. <i>Elements of Statistics with Applications to Economic Data</i> . Lester S. Kellogg . . . . .	418
DAVIS HAROLD T. <i>Tables of the Higher Mathematical Functions</i> , Vol. II. John D. Elder . . . . .	759
DAWSON, RALEIGH W. <i>Consumer Market Data Handbook: 1936</i> . Paul W. Stewart . . . . .	788
DOWRIE, GEORGE WILLIAM. <i>Money and Banking</i> . Charles S. Tippetts . . . . .	635
DUBLIN, LOUIS I. and LOTKA, ALFRED J. <i>Length of Life, A Study of the Life Table</i> . Raymond Pearl . . . . .	608
EDIN, KARL ARVID and HUTCHINSON, EDWARD P. <i>Studies of Differential Fertility in Sweden</i> . Clyde V. Kiser . . . . .	762
EINZIG, PAUL. <i>World Finance 1914-1935</i> . Eleanor Lansing Dulles . . . . .	435
EINZIG, PAUL. <i>The Future of Gold</i> . G. W. Hedlund . . . . .	631
ELDRIDGE, SEBA. <i>Public Intelligence, A Study of the Attitudes and Opinions of Voters</i> . George A. Lundberg . . . . .	423
EZEKIEL, MORDECAI. <i>\$2500 a Year</i> . George Soule . . . . .	787
FAIRCHILD, FRED ROGERS. <i>Forest Tazation in the United States</i> . John Ise . . . . .	812
FALCK, EDWARD. <i>Economics of Electric Distribution, Effects of Reduced Rates in T. V. A. Service Areas</i> . Edward S. Mason . . . . .	641
FEDERAL HOUSING ADMINISTRATION, RESEARCH DIVISION. <i>Analysis of the Real Property Inventory and Financial Survey of Urban Housing for Peoria, Illinois</i> . Howard Whipple Green . . . . .	232
FRANCIS, BION H. See Harwood, E. C.	
FREEMAN, HARRY. <i>Examples in Finite Differences, Calculus, and Probability</i> . Thornton C. Fry . . . . .	757
FRISCH, RAGNAR. <i>Statistical Confluence Analysis by Means of Complete Regression System</i> . Francis McIntyre . . . . .	619
FRITZ, WILBERT G. and VEENSTRA, THEODORE A. <i>Regional Shifts in the Bituminous Coal Industry, With Special Reference to Pennsylvania</i> . W. H. Young . . . . .	243
GAULT, EDGAR H. <i>Control of the Retail Units of Chain Stores</i> . Marie P. Sealy . . . . .	240
GAYER, ARTHUR D. <i>Public Works in Prosperity and Depression and Their Utilization as an Agency of Economic Stabilization</i> . Henry B. Arthur . . . . .	436
GLOVER, JAMES W. See Menge, Walter O.	
GOSLIN, RYLLIS ALEXANDER and GOSLIN, OMAR PANCOAST. <i>Rich Man, Poor Man—Pictures of a Paradox</i> . Frederick E. Croxton . . . . .	625
GRAY, ROBERT D. See Bezanson, Anne.	
GREEN, HOWARD WHIPPLE. <i>Real Property Inventory of the Cleveland Metropolitan District and Movements of Families within the Cleveland Metropolitan District 1934</i> . J. P. Watson . . . . .	235
GREEN, HOWARD WHIPPLE. <i>Standards of Living in the Cleveland Metro-</i>	



politan District. Theodore A. Veenstra . . . . .	438
HAIGHT, F. A. <i>French Import Quotas</i> . Ethel B. Dietrich . . . . .	224
HAMILTON, EARL J. <i>Money, Prices, and Wages in Valencia, Aragon, and Navarre, 1351-1500</i> . F. A. Pearson . . . . .	800
HARWOOD, E. C. and FRANCIS, BION H. <i>Insurance and Annuities from the Buyer's Point of View</i> . David McCahan . . . . .	237
HOLMES, Maurice C. <i>An Outline of Probability and Its Uses</i> . W. Edwards Deming . . . . .	622
HUNT, BISHOP CARLETON. <i>The Development of the Business Corporation in England 1800-1867</i> . Nathan Isaacs . . . . .	774
HUSSEY, MIRIAM. See Bezanson, Anne.	
HUTCHINSON, EDWARD P. See Edin, Karl Arvid.	
INDUSTRIAL RELATIONS COUNSELORS, INC. <i>Administration of Public Employment Offices and Unemployment Insurance: Canada, France, Sweden, Switzerland</i> . Edwin E. Witte . . . . .	452
INSTITUTE OF HUMAN RELATIONS. <i>A Handbook of Social Statistics of New Haven, Connecticut</i> . George A. Lundberg . . . . .	819
INTERNATIONAL INDUSTRIAL RELATIONS INSTITUTE. <i>On Economic Planning</i> . James G. Smith . . . . .	427
JACOBS, ALFRED and RICHTER, HANS. <i>Die Groszhandelspreise in Deutschland von 1792 bis 1934</i> . Barbara Gok . . . . .	444
KELLEY, TRUMAN L. <i>Essential Traits of Mental Life</i> . Karl J. Holzinger . . . . .	620
KEYNES, JOHN MAYNARD. <i>The General Theory of Employment, Interest and Money</i> . Joseph A. Schumpeter . . . . .	791
KRAMER, EDNA E. <i>A First Course in Educational Statistics</i> . Robert V. Young . . . . .	766
KUCZYNSKI, ROBERT R. <i>The Measurement of Population Growth</i> . P. K. Whelpton . . . . .	228
KUCZYNSKI, JUERGEN. <i>Das Problem der langen Wellen und die Entwicklung der Industriewaren-Preise in den Jahren 1820-1933 and Weltproduktion und Welthandel in den letzten 100 Jahren</i> . Eugen Altschul . . . . .	432
LABOR RESEARCH ASSOCIATION. <i>Labor Fact Book No. III</i> . Joseph M. Gillman . . . . .	651
LENTI, LIBERO. <i>Analisi di Statistica Economica</i> . William G. Welk . . . . .	424
LOKANATHAN, P. S. <i>Industrial Organization in India</i> . John E. Orchard . . . . .	443
LOTKA, ALFRED J. See Dublin, Louis I.	
LOUGH, WILLIAM H. <i>High-Level Consumption—Its Behavior; Its Consequences</i> . Emmett H. Welch . . . . .	241
LOVEKIN, OSGOOD S. See Borden, Neil H.	
LOWE, BOUTELLE ELLSWORTH. <i>The International Protection of Labor</i> . J. W. Howell . . . . .	227
LYON, LEVERETT S. and ABRAMSON, VICTOR. <i>The Economics of Open Price Systems</i> . Arthur Robert Burns . . . . .	779
MCGRANE, REGINALD C. <i>Foreign Bondholders and American State Debts</i> . Benjamin H. Williams . . . . .	231
MCKEE, SAMUEL, JR. <i>Labor in Colonial New York, 1664-1776</i> . Broadus Mitchell . . . . .	811
MAY, GEORGE OLIVER. <i>Twenty-Five Years of Accounting Responsibility 1911-1936</i> . Roy B. Kester . . . . .	772
MEANS, GARDINER C. See Ware, Caroline F.	

MEARS, ELIOT GRINNELL. <i>Maritime Trade of Western United States</i> . William H. Koenig . . . . .	440
MENGE, WALTER O. and GLOVER, JAMES W. <i>An Introduction to the Mathematics of Life Insurance</i> . James S. Elston . . . . .	766
MOULTON, HAROLD G. <i>The Formation of Capital</i> . H. Parker Willis . . . . .	218
MOULTON, HAROLD G. <i>Income and Economic Progress</i> . Emil Lederer . . . . .	629
NATIONAL INDUSTRIAL CONFERENCE BOARD, INC. <i>Machinery, Employment and Purchasing Power</i> . Harry Jerome . . . . .	217
NATIONAL INDUSTRIAL CONFERENCE BOARD, INC. <i>American Agricultural Conditions and Remedies, Preliminary General Review</i> . A. B. Cox . . . . .	638
NATIONAL INDUSTRIAL CONFERENCE BOARD, INC. <i>Unemployment Insurance</i> . Bryce M. Stewart . . . . .	646
NATIONAL INDUSTRIAL CONFERENCE BOARD, INC. <i>Vacations with Pay for Wage Earners; Wanted: Skilled Labor; Financial Incentives—A Study of Methods for Stimulating Achievements in Industry; Women Workers and Labor Supply; and What Employers Are Doing for Employees—A Survey of Voluntary Activities for Improvement of Working Conditions in American Business Concerns</i> . C. Canby Balderston . . . . .	813
NELSON, W. F. C. See Davis, Harold T.	
NETTELS, CURTIS PUTNAM. <i>The Money Supply of the American Colonies before 1720</i> . Earl J. Hamilton . . . . .	798
NEWMAN, WILLIAM H. <i>The Building Industry and Business Cycles</i> . F. L. Carmichael . . . . .	234
NEW YORK STATE DEPARTMENT OF SOCIAL WELFARE. <i>Handbook for the Collection and Tabulation of Statistical Information about Children in Foster Care by the New York State Department of Social Welfare, Handbook for the Collection and Tabulation of Statistical Information from Private Institutions for the Care of the Aged in the State of New York, and Handbook for Statistics of Mothers' Allowances</i> . MARC J. FELDSTEIN . . . . .	820
NEYMAN, J. and PEARSON, E. S. (Editors.) <i>Statistical Research Memoirs, Volume 1</i> . S. S. Wilks . . . . .	760
NOGARO, BERTRAND. <i>Les Prix Agricoles Mondiaux et la Crise</i> . Robert B. Schwenger . . . . .	637
PEARSON, E. S. <i>The Application of Statistical Methods to Industrial Standardization and Quality Control</i> . S. S. Wilks . . . . .	421
PEARSON, FRANK A. See Warren, George F.	
PEARSON, E. S. See Neyman, J.	
RANDOLPH, CAROLINA R. See Walker, W. F.	
RICHTER, HANS. See Jacobs, Alfred.	
RIGGLEMAN, JOHN R. <i>Graphic Methods for Presenting Business Statistics</i> . Frederick E. Croxton . . . . .	625
ROBBINS, LIONEL. <i>The Great Depression</i> . Glenn E. McLaughlin . . . . .	220
ROBINSON, EDGAR EUGENE. <i>The Presidential Vote, 1896-1932</i> . Harry Pelle Hartkemeier . . . . .	454
RODKEY, ROBERT G. <i>State Bank Failures in Michigan</i> . Wilbert G. Fritz . . . . .	806
ROSE, T. G. <i>Higher Control</i> . Wyman P. Fiske . . . . .	450
SASEK, IVO. <i>Les Migrations de la Population Intéressant le Territoire de la Tchecoslovaquie Actuelle</i> . Marie Jasny-Philippi . . . . .	448
SCHMALZ, CARL N. <i>Operating Results of Department and Specialty Stores in 1934</i> . James H. Greene . . . . .	643

SCHMALZ, CARL N. <i>Operating Results of Department and Specialty Stores in 1935.</i> James H. Greene . . . . .	643
SELEKMAN, B. M. <i>Law and Labor Relations, A Study of the Industrial Disputes Investigation Act of Canada.</i> Carroll R. Daugherty . . . . .	648
SMITH, JAMES GERALD. <i>Economic Planning and the Tariff: An Essay on Social Philosophy.</i> Abraham Berglund . . . . .	429
SMITH, WALTER B. and COLE, ARTHUR H. <i>Fluctuations in American Business 1790-1860.</i> Walter A. Baude . . . . .	434
SMITH, RAYMOND F. and WINAKOR, ARTHUR H. <i>Changes in the Financial Structure of Unsuccessful Industrial Corporations.</i> Jacob Swart . . . . .	239
SODDY, FREDERICK. <i>The Role of Money.</i> James F. Cusick . . . . .	223
SORENSEN, HERBERT. <i>Statistics for Students of Psychology and Education.</i> Herbert A. Toops . . . . .	624
STANFORD UNIVERSITY. <i>Wheat Studies of the Food Research Institute.</i> W. M. Drummond . . . . .	225
STANFORD UNIVERSITY. <i>Wheat Studies of the Food Research Institute.</i> Roland S. Vaile . . . . .	815
STATE UNIVERSITY OF SOFIA, BULGARIA. <i>Publications of the Statistical Institute for Economic Research.</i> V. P. Timoshenko . . . . .	442
SWEENEY, HENRY W. <i>Stabilized Accounting.</i> T. H. Sanders . . . . .	771
TAGGART, HERBERT F. <i>Minimum Prices under the NRA.</i> Leverett S. Lyon . . . . .	780
TAYLOR, ALONZO E. <i>The New Deal and Foreign Trade.</i> C. E. Griffin . . . . .	214
TEELE, STANLEY F. <i>Expenses and Profits of Limited Price Variety Chains in 1934.</i> James H. Greene . . . . .	643
TINTNER, GERHARD. <i>Prices in the Trade Cycles.</i> Solomon Fabricant . . . . .	212
TITUS, CHARLES HICKMAN. <i>Voting Behavior in the United States.</i> Harry Pelle Hartkemeier . . . . .	454
VEENSTRA, THEODORE A. See Fritz, Wilbert G.	
VINCI, FELICE. <i>Manuale di Statistica.</i> Wassily Leontief . . . . .	422
VIRGILII, FILIPPO. <i>Statistica.</i> Wassily Leontief . . . . .	422
VON MISES, RICHARD. <i>Wahrscheinlichkeit, Statistik und Wahrheit.</i> Edward L. Dodd . . . . .	758
WALKER, W. F. and RANDOLPH, CAROLINA R. <i>Recording of Local Health Work.</i> C.-E. A. Winslow . . . . .	447
WARE, CAROLINE F. and MEANS, GARDINER C. <i>The Modern Economy in Action.</i> L. A. Morrison . . . . .	776
WARREN, GEORGE F. and PEARSON, FRANK A. <i>Gold and Prices.</i> George K. McCabe . . . . .	805
WILLIAMS, FAITH M. and ZIMMERMAN, CARLE C. <i>Studies of Family Living in the United States and Other Countries: An Analysis of Material and Method.</i> Warren C. Waite . . . . .	617
WILLIS, H. PARKER and CHAPMAN, JOHN M. <i>The Economics of Inflation, The Basis of Contemporary American Monetary Policy.</i> Robert W. Burgess . . . . .	795
WINAKOR, ARTHUR H. <i>Financial Aspects of Corporate Net Worth.</i> Jacob Swart . . . . .	239
WINAKOR, ARTHUR H. See Smith, Raymond F.	
ZIMMERMAN, CARLE C. See Williams, Faith M.	

# REVIEWERS

- |                                   |                               |                            |
|-----------------------------------|-------------------------------|----------------------------|
| ALTSCHUL, EUGEN, 432              | FRY, THORNTON C., 757         | MORRISON, L. A., 776       |
| ARTHUR, HENRY B., 436             | GILLMAN, JOSEPH M., 651, 789  | MORTON, W. A., 802         |
| BALDERSTON, C. CANBY, 813         | GOK, BARBARA, 444             | ORCHARD, JOHN E., 443      |
| BAUDE, WALTER A., 434             | GREEN, HOWARD WHIPPLE, 232    | PALYI, MELCHIOR, 783       |
| BERGLUND, ABRAHAM, 429            | GREENE, JAMES H., 643         | PEARL, RAYMOND, 608        |
| BLAIR, JACOB J., 441              | GRIFFIN, C. E., 214           | PEARSON, F. A., 800        |
| BOGEN, JULES I., 809              | HAMILTON, EARL J., 798        | ROOS, CHARLES F., 420, 627 |
| BROWNE, H. F., 650                | HARTKEMEIER, HARRY PELLE, 454 | SANDERS, T. H., 771        |
| BRUMBAUGH, M. A., 238             | HAYES, H. GORDON, 642         | SCHULTZ, HENRY, 613        |
| BURGESS, ROBERT W., 795           | HEDLUND, G. W., 631           | SCHUMPETER, JOSEPH A., 791 |
| BURNS, ARTHUR ROBERT, 779         | HOLZINGER, KARL J., 620       | SCHWENGER, ROBERT B., 637  |
| CARMICHAEL, F. L., 234            | HOWELL, J. W., 227            | SEALY, MARIE P., 240       |
| COX, A. B., 638                   | HOWELL, PAUL L., 809          | SHOUP, CARL, 453           |
| CRATHORNE, A. R., 417             | ISAACS, NATHAN, 774           | SMITH, JAMES G., 427       |
| CROXTON, FREDERICK E., 625        | ISE, JOHN, 812                | SOULE, GEORGE, 787         |
| CRUM, W. L., 767                  | JASNY-PHILIPPI, MARIE, 448    | STEWART, BRYCE M., 646     |
| CUSICK, JAMES F., 223             | JEROME, HARRY, 217            | STEWART, PAUL W., 788      |
| DAUGHERTY, CARROLL R., 648        | KELLOGG, LESTER S., 418       | SWART, JACOB, 239          |
| DEMING, W. EDWARDS, 622           | KESTER, ROY B., 772           | TIMOSHENKO, V. P., 442     |
| DEWHURST, FREDERIC, 785           | KISER, CLYDE V., 762          | TIPPETTS, CHARLES S., 635  |
| DIETRICH, ETHEL B., 224           | KOENIG, WILLIAM H., 440       | TOOPS, HERBERT A., 624     |
| DODD, EDWARD L., 758              | LEDERER, EMIL, 629            | TUCKER, R. S., 430         |
| DRUMMOND, W. M., 225              | LEONTIEF, WASSILY, 422        | VAILE, ROLAND S., 815      |
| DU BOIS, EUGENE F., 765           | LOCKLEY, LAWRENCE C., 449     | VEENSTRA, THEODORE A., 438 |
| DULLES, ELEANOR LANSING, 435, 633 | LOVITT, W. V., 425            | WAITE, WARREN C., 617      |
| ELDER, JOHN D., 759, 760          | LUNDBERG, GEORGE A., 423, 819 | WARREN, G. F., 803         |
| ELSTON, JAMES S., 766             | LYON, LEVERETT S., 780        | WATSON, J. P., 235         |
| EPSTEIN, RALPH C., 770            | McCABE, GEORGE K., 805        | WELCH, EMMETT H., 241      |
| FABRICANT, SOLOMON, 212           | McCAHAN, DAVID, 237           | WELK, WILLIAM G., 424      |
| FELDSTEIN, MARC J., 820           | McINTYRE, FRANCIS, 619        | WHELPTON, P. K., 228       |
| FISKE, WYMAN P., 450              | McKAY, EVELYN C., 230         | WILKS, S. S., 421, 760     |
| Fritz, WILBERT G., 446, 806       | McLAUGHLIN, GLENN E., 220     | WILLIAMS, BENJAMIN H., 231 |
|                                   | MASON, EDWARD S., 641         | WILLIAMS, FAITH M., 610    |
|                                   | MITCHELL, BROADUS, 811        | WILLIS, H. PARKER, 218     |
|                                   |                               | WINSLOW, C.-E. A., 447     |
|                                   |                               | WITTE, EDWIN E., 452       |
|                                   |                               | YOUNG, ROBERT V., 766      |
|                                   |                               | YOUNG, W. H., 243          |
|                                   |                               | ZELOMEK, A. W., 239        |



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## CONTENTS

Consolidating Our Gains. By WILLFORD I. KING . . . . .	1
The Meaning of Probability. By ERNEST NAGEL . . . . .	10
Some Uses of Statistics in Executive Control. By F. LESLIE HAYFORD . . . . .	31
Bases of Control for Industrial Operation. By FAIRFIELD E. RAYMOND . . . . .	37
The Kind of Information an Executive Needs to Operate a Factory. By WALTER F. TITUS . . . . .	43
Wanted—Industrial Statistics. By WILLARD L. THORP . . . . .	47
A Proposal for an Integrated Program for the Reporting of Business Statis- tics to Government Agencies. By S. M. DUBRUL . . . . .	53
Effect of N.R.A. on the Physical Volume of Production. By LEONARD KUVIN . . . . .	58
Unemployment Insurance and Unemployment. By M. C. RORTY . . . . .	61
Setting Up State Administration for Unemployment Insurance. By GLENN A. BOWERS . . . . .	67
Real Wages of Artisans in London, 1729-1935. By RUFUS S. TUCKER . . . . .	73
Price Stability and Responsiveness to Changes in the Price of Gold. By PAUL M. DENSEN . . . . .	85
Statistics Relating to Security Markets and Corporations. By PAUL P. GOUBRICH . . . . .	88
Significance of the Lending Function of the Federal Reserve Banks. By E. A. GOLDENWEISER . . . . .	95
Deposit Insurance as an Influence for Stabilizing the Banking Structure. By MORTIMER J. FOX, JR. . . . .	103
The Evaluation of the Effect upon Mortality Statistics of the Selection of the Primary Cause of Death. By HALBERT L. DUNN . . . . .	113

## NOTES

The Present Interests of Physicists in Statistics. By W. EDWARDS DEMING . . . . .	124
A Correction . . . . .	126
Statistics in Chinese Agricultural Research. By JOHN WISHART . . . . .	127
The Institute of Mathematical Statistics . . . . .	128
Coöperative Research on Prices . . . . .	128
Conference on National Income and Wealth . . . . .	130

*Continued on next page*

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The Editor welcomes the submission of articles and notes for possible publication in the Journal. A statement of editorial policies and suggestions for the preparation of manuscripts, tables and charts may be obtained from the Editorial Office.

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# NOTES—Continued

Special Studies on Statistics of Income. By GEORGE C. HAAS . . . . .	132
Plans for a Study of the Consumption of Goods and Services by American Families. By HILDEGARDE KNEELAND, ERIKA H. SCHOENBERG, and MILTON FRIEDMAN . . . . .	135
Progress of Work in the Census Bureau . . . . .	141
Chapter Activities . . . . .	144
Statistical News and Notes: Bureau of Statistics, Interstate Commerce Commission (153); Federal Trade Commission (153); Bureau of Foreign and Domestic Commerce (155); Division of Economics and Statistics, Federal Housing Administration (156); Bureau of Mines (157); Bureau of Labor Statistics, Department of Labor (157); United States Employment Service (158); Bureau of Agricultural Economics (160); Farm Credit Administration (161); Board of Governors of the Federal Reserve System (162); U. S. Public Health Service (162); Division of Vital Statistics, Bureau of the Census (162); Women's Bureau, Department of Labor (163); Ohio College Association (164); Office of Education (164); Division of Research, Statistics, and Records, Works Progress Administration (165); Division of Social Research, Works Progress Administration (165); Coördinating Committee of the Central Statistical Board and the Works Progress Administration (167); Central Statistical Board (167); University of Oxford (168); University of Paris (168); American Mathematical Society (169).	
Personal Notes . . . . .	169
New Members . . . . .	169

## PROCEEDINGS OF THE NINETY-SEVENTH ANNUAL MEETING

Program of the Annual Meeting . . . . .	173
Minutes of the Annual Business Meeting . . . . .	181
Report of the Secretary . . . . .	186
Report of the Treasurer . . . . .	187
Report of the Auditing Committee . . . . .	192
Report of the Editor . . . . .	192
List of Committees for 1935 . . . . .	193
Reports of Committees and Representatives	
Committee on Fellows . . . . .	197
Committee on Government Statistics and Information Services . . . . .	197
Advisory Committee to the Secretary of Labor . . . . .	198
Representatives on the Joint Advisory Committee on the Census . . . . .	199
Committee on Census Enumeration Areas . . . . .	201
Committee on Technique and Method . . . . .	202
Committee on Statistics of Institutions for Mental and Physical Disorders . . . . .	203
Representative on the Board of Directors of the National Bureau of Economic Research . . . . .	206
Members of the Social Science Research Council . . . . .	207
Representatives on the Committee to Advise the New York State Department of Social Welfare . . . . .	209
Representative on the Joint Committee for the Development of Statistical Applications in Engineering and Manufacturing . . . . .	211

## REVIEWS

Tintner: <i>Prices in the Trade Cycles</i> , by SOLOMON FABRICANT . . . . .	212
Taylor: <i>The New Deal and Foreign Trade</i> , by C. E. GRIFFIN . . . . .	214
National Industrial Conference Board, Inc.: <i>Machinery, Employment and Purchasing Power</i> , by HARRY JEROME . . . . .	217
Moulton: <i>The Formation of Capital</i> , by H. PARKER WILLIS . . . . .	218
Robbins: <i>The Great Depression</i> , by GLENN E. McLAUGHLIN . . . . .	220
Soddy: <i>The Role of Money</i> , by JAMES F. CUSICK . . . . .	223
Haight: <i>French Import Quotas</i> , by ETHEL B. DIETRICH . . . . .	224
Stanford University: <i>Wheat Studies of the Food Research Institute</i> , by W. M. DRUMMOND . . . . .	225

Continued on next page

# REVIEWS—Continued

Lowe: <i>The International Protection of Labor</i> , by J. W. HOWELL . . . . .	227
Kuczynski: <i>The Measurement of Population Growth</i> , by P. K. WHELPTON . . . . .	228
Best: <i>Blindness and the Blind in the United States</i> , by EVELYN C. MCKAY . . . . .	230
McGrane: <i>Foreign Bondholders and American State Debts</i> , by BENJAMIN H. WILLIAMS . . . . .	231
Research Division of the Federal Housing Administration: <i>Analysis of the Real Property Inventory and Financial Survey of Urban Housing for Peoria, Illinois</i> , by HOWARD WHIPPLE GREEN . . . . .	232
Newman: <i>The Building Industry and Business Cycles</i> , by F. L. CARMICHAEL . . . . .	234
Green: <i>Real Property Inventory of the Cleveland Metropolitan District and Movements of Families within the Cleveland Metropolitan District 1934</i> , by J. P. WATSON . . . . .	235
Harwood and Francis: <i>Insurance and Annuities from the Buyer's Point of View</i> , by DAVID MCCAHAN . . . . .	237
Blodgett: <i>Cyclical Fluctuations in Commodity Stocks</i> , by M. A. BRUMBAUGH . . . . .	238
Cover: <i>Retail Price Behavior</i> , by A. W. ZELOMEK . . . . .	239
Winakor: <i>Financial Aspects of Corporate Net Worth and Smith and Winakor: Changes in the Financial Structure of Unsuccessful Industrial Corporations</i> , by JACOB SWART . . . . .	239
Gault: <i>Control of the Retail Units of Chain Stores</i> , by MARIE P. SEALY . . . . .	240
Lough: <i>High-Level Consumption—Its Behavior; Its Consequences</i> , by EMMETT H. WELCH . . . . .	241
Fritz and Veenstra: <i>Regional Shifts in the Bituminous Coal Industry, With Special Reference to Pennsylvania</i> , by W. H. YOUNG . . . . .	243





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## CONSOLIDATING OUR GAINS\*

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*New York University*

STATISTICS is frequently referred to as one of the youngest of the sciences, and it is undoubtedly true that youth is a characteristic of a large proportion of the complicated technique now employed in dealing with masses of data. This is, however, far from saying that the most elementary principles of statistics are of recent origin. Bowley defines statistics as "the science of counting." If we accept this definition, it follows that, among early statisticians, we must certainly include both the clever Inca who devised a method of enumerating his llamas by tying knots in his whips, and the keen-minded Roman who converted a crude system of tallying into a notation which enabled him to compare at a glance the sizes of large numbers.

Enumeration forms the prime basis for both mathematics and accounting, and without these aids, it is hard to conceive of social organization advancing to any noticeable extent. Apparently, therefore, we statisticians cannot be accused of undue boasting if we assert that, to no small degree, civilization rests upon a statistical foundation.

It must be admitted, however, that such records as have come down to us seem to indicate that, before the Renaissance, statistical work, for the most part was confined mainly to simple enumerations of population or property. There were, however, notable exceptions to this rule. Researches conducted by that careful and erudite student of statistical lore, the late Edwin W. Kopf, indicated that the life tables devised by the vital statisticians of Augustus Caesar's day were practically applied in Italy for something like a thousand years. What is even more astounding, he found that, in Ancient Babylon, our science

\* Presidential address at the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 30, 1935.

had made such remarkable progress that life tables were available and were used in writing most of the forms of life insurance in vogue in the United States today. Who knows but that while we are celebrating, in 1939, the centenary of the American Statistical Association, and preening ourselves upon the long life of our organization, the cables may carry a message something like the following:

"Archaeologists unearthed today in Babylon a remarkable set of clay tablets recording the minutes of the 1242nd annual meeting of the Babylonian Statistical Association."

In view of the fact that these achievements of ancient statisticians have for so long been lost in the mists of antiquity, it may well be that other of our supposedly new devices may be nothing more than revivals of procedures, once commonly employed, but now long forgotten. Until, however, evidence to this effect is forthcoming, the conclusion seems to be warranted that until comparatively recent times, statistics, for the most part, consisted merely of more or less complete enumerations of the inhabitants, and especially of the fighting men and resources needed for war purposes. The very name statistician indicates clearly that the original worker in this field was looked upon primarily as a servant of the state.

As long as statisticians served mainly in that capacity, the utilitarian nature of their work seemed clear to nearly everyone. When, however, in the Seventeenth Century, Obrecht, Graunt, Neumann, and Petty began dabbling in records of births and deaths, the practical man of the day probably looked upon these four, much as we now do upon the collectors of the wooden Indians, which once stood before cigar stores. When, however, a little later, Halley, by aid of their figures, rediscovered the art of making mortality tables and thus established the basis for modern life insurance, it became evident that the work of even these visionaries possessed a high degree of utility. Similarly, when mathematicians like Pascal, the Bernoullis, de Moivre, Gauss, Laplace, Cournot, and Poisson developed the theory of probability, the chances are that few people believed that this theory could ever be applied to problems relating to everyday life. However, even while the theory was developing, Süszmilch, Necker, Malthus, Fuchs, Lombard, Quetelet, Farr, and many other lesser lights, were showing that such abstract mathematical research was of real importance in solving the social problems of the day.

Perhaps it was observation of the fact that so many important practical results were being unexpectedly derived from masses of apparently useless data which led Lavoisier, writing around 1791, to announce that if only the French National Assembly would arrange to collect

adequate information concerning agriculture, population, commerce, etc., the resulting report "would contain in a small number of pages the entire science of political economy, or rather this would cease to exist; for the results would be so clear, so palpable; the different questions which one could raise would be so easy to resolve, that it would no longer be possible to have any diversity of opinion."<sup>1</sup>

Antoine Lavoisier has long since been gathered to his fathers. For many years, the masses of statistical information for which he prayed have been collected and placed at our beck and call. Every decade, for example, our Census Bureau fills an eight-foot shelf with thin-leaved volumes closely packed with figures, and from these we can glean information on a thousand topics. Much progress has undoubtedly been made in the direction of putting the social sciences upon a firmer foundation. Even so, however, if, during the last few days, the shade of Lavoisier has happened in at our sessions, it is to be feared that he has been both surprised and grieved to learn that, despite the numerous statistical tomes at their disposal, some of our most highly trained specialists are not in perfect accord as regards the wisdom of the Government's spending policy, that others are not in complete harmony on the money question, and that some few even show traces of disagreement concerning the merits of the various phases of the New Deal.

With our present accumulation of hind sight, Lavoisier's faith in the potency of massed figures seems strangely naïve. It may well be, however, that, had we lived in Lavoisier's day, we too might have felt that, with an adequate supply of data, the truth would inevitably stand clearly revealed.

It was only after many decades of experience with masses of data, that statisticians learned that one cannot build the tower of science merely by piling figures upon figures. Two generations after Lavoisier, the German Historical School of economists still exhibited for masses of data a reverence and faith almost as childlike as that of Lavoisier.

Lavoisier's enthusiasm over statistics—the new device which seemed so promising—is easily comprehensible. The undue persistence of this point of view was, however, unfortunate, for it led to the waste of much energy in the gathering of data which were practically useless when collected. Wherever there prevailed this emphasis upon data, rather than upon reasoning, science made but little progress.

This does not mean, however, that one is justified in belittling the importance of having adequate statistical bases upon which to build our scientific superstructures. In the United States, we are, indeed

<sup>1</sup> Quoted by Harold Westergaard in his *Contributions to the History of Statistics*, p. 99.

fortunate in having available as foundation material our magnificent collections of Census data. The student of dynamic economic and social problems should be ever grateful for the *Statistical Abstract* and the *Survey of Current Business* which gather together in extremely convenient form numerous series of comparable annual or monthly figures, which series enable him to interpolate between the Census dates and thus measure changing relationships of cause and effect. Unfortunately, however, there is one fly in the statistician's ointment. It is that, all too frequently, no coördination exists between the basic Census data and the series which must be used for purposes of interpolation. For example, the United States Bureau of Labor Statistics collects various series recording changes in hours worked per week, but one searches the Census in vain for corresponding data. Similarly, the United States Bureau of Agricultural Economics notes changes in the rates of pay of agricultural workers paid by the month and of others paid by the day, but the Census figures do not tell us how many workers were paid in each manner during the Census period. On the other hand, the Bureau of the Census records the number of persons reporting themselves as bookkeepers at the beginning of each decade, but we have no annual index from which to estimate the changes which are occurring from year to year in the size of this group.

Fortunately, real progress is being made in the direction of coördinating the statistics collected by different Federal Departments, and many gaps are being filled in. On the whole, we are justified in taking great pride in our splendid collection of basic statistical information, and we should feel it our duty to work for the improvement of these essential figures. At the same time, however, we should remember that collecting basic material is an extremely expensive process, and that, in deciding what additional data are worth while, the interests of the taxpayers, as well as those of the users of statistics, should always be kept in mind. In every instance, the question should be raised: "Are the figures worth what they cost?"

There can, for example, be no doubt that we statisticians are served better by having a census of agriculture every five years than by having one every ten years—and that it is also to our advantage to have biennial rather than quinquennial or decennial censuses of manufactures. When, however, we consider the great number of year by year and month by month series prepared by the Bureau of Agricultural Economics, by the Department of Labor, or by the Department of Commerce, and when we consider further the fact that frequency of enumeration often means a sacrifice in the completeness of each and every enumeration, and hence the disappearance of any really adequate

census basis for many series, a question arises as to whether the extra dollars invested by the taxpayers in order to secure frequent enumerations might not be better spent.

At present, plans are being completed to make the population census quinquennial rather than decennial. In view of the fact that our Association has repeatedly endorsed this move, I realize that to question its advisability may be near treason. It goes without saying that health officers need reasonably accurate bases for use in computing sickness rates. Are we sure, however, that, were we to expend on the utilization of existing data one tenth of the cost of a census, it might not prove feasible to approximate closely enough for practical purposes the population of all the larger segments of the United States? Can we justify the expenditure of millions of dollars for an additional population census before any serious effort has been made to ascertain whether or not data already available can be made to yield the major part of the information which the census is designed to provide?

It is undoubtedly true that statistical science can get nowhere unless it is based upon a broad and firm foundation of accurate data. This foundation needs, however, to be built according to plan, and to have the various sections carefully coördinated. Furthermore, in planning the foundation, the matter of cost should always be kept in mind, for cost is as important to the nation as to any private builder.

Unfortunately, in our own as well as other countries, the rules just laid down have been as frequently overlooked as observed. We have had far too much sporadic and often aimless collection of data. With a faith as childlike as that of Antoine Lavoisier, Congressional Committees vote for elaborate inquiries without having any clear understanding of what uses can be made of the figures after they have been collected. In some cases, the result is to clutter the archives with cords of dust-gathering volumes of figures answering no definite questions and related to none of the major bodies of existing data. At the same time that Congress appropriates money for such aimless figure collecting excursions, it hesitates long to furnish the very minor sums needed to pay for publishing important tabulations obtained in connection with the regular decennial Census.

While Congress has often been guilty of fostering the collection of masses of practically useless data, it has remained for the present Alphabetocracy to reduce this process to a fine art. To no small extent, this has been the result of considering figure gathering, along with boondoggling, as an ideal form of "made work." When a lazy-minded or unimaginative relief administrator cannot conjure up anything useful for his "white collared" protégés to do, he can always set them to

counting one thing or another. A favorite task seems to be the impossible one of counting the number of unemployed. Perhaps one of the reasons adding materially to the attractiveness of this undertaking is the difficulty of deciding whether the counter himself is or is not unemployed.

Not only relief, but the general necessities of a modern bureaucracy require figure collecting on a hitherto unheard of scale. Formerly, John Smith, God and his wife permitting, planted his corn and cotton and sold his hogs and potatoes when and where he pleased. Today he must file a detailed report of his past performances (whether actual or constructive depending upon his ethical standards and the prying proclivities of his neighbors), and of the program which he nominally, or perhaps really, intends to follow in the future. Handling these reports provides jobs for an army of statistical clerks and prestige for many a hitherto unknown administrator. And so it is likewise in many other industries, and would be in all were it not for the unhappy tendency of the Supreme Court to blight the promising careers of so many embryo statisticians and bureaucrats. However, we can all find some solace in the fact that the fledgelings of the late, and by some lamented, blue eagle were given a year in which to record statistically the numerous deeds and misdeeds characterizing his brief but colorful existence.

At present, we statisticians are likely to find ourselves torn by two conflicting emotions. As breadwinners, we realize that the more figure collecting is done, the stronger is the demand for statisticians and the greater the probability that we can add to our supply of shekels. As scientists, on the other hand, we know that the public in general, and business men in particular, are becoming so annoyed by the growing number of calls for statistical data that they are refusing to furnish to long established Governmental agencies such as the Bureau of the Census, the information needed as a foundation for all our statistical studies. Furthermore, as citizens, we cannot overlook the fact that many of the inquiries are costing far more than the results are worth. Perhaps we may more readily overcome the urgings of self-interest if we pause to consider the fact that increased demand for statistical workers soon generates an increased supply, and that therefore, our monetary gains are likely, at best, to be but short-lived.

Clearly, the national welfare demands an adequate, but not excessive, mass of sound, thoroughly coördinated data as a base line upon which our advances must be founded. The best way to advance from this base line, is by means of studies carefully designed to answer very specific questions. In selecting questions to be answered, we should always consider both the importance of having the question answered

and the cost of answering it. To know whether there are eight millions or ten millions of people who call themselves unemployed may be interesting but of slight importance. In either case, the number is vastly too large. The thing which is important is to know why many people are idle and how they can be set to work producing useful goods. Perhaps the latter information can be gathered at but a fraction of the cost of the former.

During the last quarter century, both governmental and private research organizations, and also many individual statisticians, have been diligently and successfully engaged in pushing forward important lines of knowledge. Up to the last decade, it was commonly assumed that any statistical advance made anywhere would automatically become the gain of all science. Perhaps the Social Science Research Council was the first body forcefully to call attention to the fact that various individuals and organizations were often completely unaware that others were working along almost identical lines. It remained, however, for the depression year of 1930 to 1932 to bring out vividly the fact that the world at large knew almost nothing of the facts established by statistical research. Most of the ancient fallacies which the scientists of a century ago considered they had laid to rest for all time, were resurrected and their ghosts were soon warmly accepted in high circles as being real flesh and blood.

Apparently in complete ignorance of the facts so clearly established by the painstaking research of men like Carl Snyder and O. E. Baker, scaremongers told us that the nation was about to be overwhelmed by a sudden deluge of products from our farms and factories, and that we must, therefore, prepare to maintain in permanent idleness a large proportion of the nation's erstwhile working force. Others, equally uninformed concerning the work of the Brookings Institution, the National Bureau of Economic Research, and the National Industrial Conference Board, asserted vehemently that we were suffering from having invested too much of our resources in machinery and equipment and that we were in danger of being crushed by overcapacity for production. While not all of these ghosts have yet been driven back to their graves, it is gratifying to report that marked progress in that direction is clearly visible.

Perhaps this habit of reviving economic and statistical fallacies is inherent in the depression spirit. However, other sciences do not suffer similarly. The business collapse of 1929 to 1932 did not cause geographers to return to the belief that the world is flat, did not cause biologists to revert to the idea that sickness was the result of witchcraft, did not even revive among chemists the phlogiston theory. The tend-



ency to resurrect long-dead fallacies seems to be peculiar to the social science. Perhaps this defect is inherent and cannot be remedied, but it seems worth while to make some attempt to effect a cure.

One thing which the field of statistics obviously lacks is a convenient way of discovering, as regards any given subject, what statistics are available. In other words, we need an adequate bibliography of statistical material. Existing bibliographers as a rule, refer merely to whole volumes of figures and tell little or nothing about their contents. There is, for example, no catalogue to which one may turn and learn what statistical material exists which bears upon any particular subject.

The research worker often can do no more than grope blindly in the hope that he will stumble onto the figures which he desires. How, for example, can he be expected to know that a study of Negroes in industry appears in a monograph prepared by the Pennsylvania Department of Internal Affairs, that to find information concerning distribution of incomes by occupations he had best refer to a report of the New York State Tax Commission?

The lack of such an adequate bibliography of statistical material makes it impossible to avoid repeated duplication of effort. It also retards progress by preventing one statistician from building upon what another has done. The way to advance successfully is to have full coördination of effort—not to have each man depending solely upon his own diligence and ingenuity. A well organized catalogue of statistical information would greatly further such coördination.

To compile a really helpful bibliography would be a huge undertaking, for it would be necessary for the catalogues not only to differentiate source and secondary material but also to distinguish between statistical tables which are the results of years of effort by competent statistical staffs and those which represent nothing more than hasty guesses made by some enthusiastic publicist. The rating of statistical data would seem to be no impossible task but obviously it could only be done successfully by highly trained workers. To obtain such workers would add greatly to the expense of the enterprise. The Government could, however, much better afford to spend millions upon a project like this, which would strengthen greatly the foundations underlying all statistical work, than to pay out like sums for the collection of masses of data having at best transitory value. The construction of a great card catalogue citing and relating statistical data would be one way of consolidating the gains made by statistical science. It would be an expensive way, but would probably be worth more than it would cost. Fortunately, the preparation of a colossal card catalogue of statistics does not represent the only possible method of consolidating our gains. As previously stated, many statisticians have individually

advanced far ahead of the base trenches. They have proceeded by varying routes, and it is therefore hard to visualize the new advanced line which they have attained. Their positions need tying together.

The most feasible way of doing this seems to be to have competent and unbiased committees of specialists look into the results of the various studies known to exist in a given field, and thus ascertain exactly what facts have been thoroughly established and what lines of investigation need to be pursued further.

It is highly probable, for example, that, *in toto*, ample statistics are available to settle such questions as the following:

1. The effect of changing income upon the birth rate.
2. The relationship between temperature and sickness rates.
3. The effect of wage rates upon the volume of employment.
4. The interrelationships of money, credit, and prices.
5. The connection between price and wage rigidity and unemployment.
6. The effect of length of working time upon production.
7. The causes of depression.

Nevertheless, it is safe to assert that many skilled statisticians, to say nothing of laymen, are not sufficiently versed in the literature of the subject to distinguish between findings based upon adequate evidence and the mere assertions of ignorant enthusiasts or charlatans.

It is hoped that our recently formed Committee to Appraise the Statistical Evidence Concerning the Present Depression will blaze a trail which can be followed by similar committees dealing with other subjects. Were a series of such committees formed, each to evaluate and consolidate all available evidence relating to the particular subject assigned to the committee, the probabilities are that the results would be extremely beneficial not only to statisticians and social scientists but to the public at large.

At present, the crying need is not for more basic data, is not even for more research. What is really important is to enlighten the public in general, and our policy making and administrative officials in particular, concerning facts thoroughly established and well understood by specialists in the various fields of social science. Eventually, we hope and indeed fully expect to advance our outposts far beyond their present positions. Temporarily the forces of darkness are yielding ground slowly, but they may counter-attack. As Dr. Frederick C. Mills pointed out in his presidential address last year, we are inclined to take order and security for granted—just as we do air. The truth is, however, that eternal vigilance is the price of liberty. Since this is the case, the policy which at present is safest is to proceed at once to consolidate our gains.

# THE MEANING OF PROBABILITY\*

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THERE is at least the appearance of presumption in the title of this paper. The title could be taken to imply that my object was either to legislate what meaning the term "probability" *must* have, or to settle summarily the many difficult problems which an analysis of the meaning of the term faces. Reflection on the follies of other philosophers who have ruled out as "meaningless" the meanings which scientists have assigned to certain terms, prevents me from undertaking the former task; and limitations of space, to say nothing of my own sense of unsolved difficulties, makes it impossible to attempt the latter. All that I wish to do is to make explicit certain generally recognized methodological principles to which, I believe, all rational inquiry appeals, and to test by their means three analyses of the meaning of "probability" which have been offered. One of Dickens' characters composed an essay on Chinese metaphysics by combining the contents of the encyclopaedia article on metaphysics with the information obtained from the article on China. However, even if, like the essay in *Pickwick Papers*, the present paper is simply a mechanical juxtaposition of some reflections on methodology and others on probability, I hope it succeeds in showing the relevance of the former to the discussion of the meaning of the latter.

## I

I begin with the methodological principles.

1. If the term "probability" were being introduced for the first time, or in some special technical sense, into every-day or scientific language, its meaning would be given by specifying the occasion when it is to be employed, and by stating the rules which would govern its occurrence and relations to other terms in the language. Such a definition would be nominal and arbitrary, because the meaning of the term would be established by a resolution or convention, so that questions involving truth or falsity would not be relevant concerning the definition. Thus, the expression "work done by a body" was introduced as a technical term into physics by Coriolis, who used it to mean distance multiplied by the component of force. There are often good practical

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reasons for introducing new terms into a language in this arbitrary way; and having once fixed the meaning of a term, it is of course no longer an arbitrary matter whether, for example, a given body is performing work or not. Nevertheless, the initial specification of meaning is arbitrary, because every dispute about the meaning would be decided by an appeal to a resolution made, and not by an appeal to matters of objective fact.

With respect to the term "probability" such is not the situation in which we find ourselves, except in those cases where a writer explicitly stipulates that he will employ it in some unique sense. The term is of great antiquity and is used in more or less determinate ways in various contexts. What it *does* mean in any given context cannot therefore be decided by an arbitrary resolution as to what it *shall* mean; and we cannot rule out some usages of the term as "meaningless" merely on the ground that such a usage does not conform to the usage we have decided to give it. Hence, whether the term "probability" has one meaning or many must be determined by a study of the different contexts in which it is employed. The univocality or equivocality of the term cannot be determined *prior* to such a study.

There seems to be but one reliable way of discovering what meaning or meanings the term "probability" does in fact have. For people assert propositions like "It is probable that it will snow to-night," "The probability that he will survive the operation is  $3/5$ ," "The photon has a probability of  $3/4$  of being reflected," "The helio-centric theory is more probable than the geo-centric one," and so on. Now we would discover what is meant by these propositions and consequently by "probability," if we could ascertain rules controlling the assertion of each, and therefore of the usage of the term. To put the matter in different language, if we can obtain an answer to the question "What *sort of evidence* would be regarded as relevant for propositions asserting something about probabilities?" we would obtain at the same time an answer to the question "What is meant by probability?"

This point may be made clearer by an illustration. Suppose a person *X* were to assert the proposition "Events *A* and *B* are simultaneous," and were to give as evidence for it the proposition that he saw them occurring within one specious moment. We would now know what *X* means by "simultaneity"; and we could legitimately conclude that he would judge a sudden increase in the brightness of each of two stars lying in an approximately straight line with his eyes as simultaneous events, if he were to observe the change in brightness within the same specious moment. On the other hand, if a person *Y* were to give as evidence for the proposition "Events *A* and *B* are simultaneous," the

proposition that an instrument placed half-way between them registers light rays having *A* and *B* as their source within a small interval of time as measured by a clock on the instrument, we would also know what *Y* means by "simultaneity"; and we could conclude that what *X* means by the term is not in general identical with what *Y* means by it.

It is an inquiry of this sort which seems to me necessary for determining what the term "probability" means. Such an inquiry is more than a project in anthropology or linguistics. For consider the following imagined situation: In virtue of what the term "work" means in physics, and by using other physical principles and data, we may validly infer from the proposition that a given body has performed a certain quantity of work another proposition, for example, that some other body suffers specifiable deformations. We are thus able to predict empirical states of affairs not yet examined and to regulate our behavior accordingly. Now suppose a person *X*, unfamiliar with the specific meaning and function of the term "work" as employed in physics, nevertheless believes that when a doorman of a hotel is said to be "working," just the same sort of consequences can be validly inferred from this as in the preceding illustration. It would still be the case that the term "work" would have a meaning for *X*, though a confused one. Nevertheless, it would be proper to criticise his use of the term "work" on the ground that the consequences he draws are not valid ones.

Now I think the way "probability" is frequently employed illustrates confusions similar to this one; propositions are sometimes believed to be validly inferable from propositions about probabilities when in fact such inferences are not justifiable in the light of the meaning, whether confused or not, ascribed to the term "probability." Hence, while I do not believe it is the philosopher's task to legislate away any of the meanings which "probability" may have, I think it is his task to *distinguish* between different meanings. It is also his task to evaluate the cogency of arguments which claim that propositions about probabilities are adequate premises for certain kinds of conclusions, and to suggest what the term *ought* to mean, and what it *could not* mean if the conclusions are to be valid consequences.

2. The second point I wish to make concerns the conditions for an empirically significant theory. Every theory is required to be formulated in such a manner that determinate propositions may be inferred from it by logical means alone. And furthermore, it is requisite that among the logical consequences of a theory there must be propositions which are capable of empirical corroboration or refutation. In brief, theories must be verifiable.

It will be obvious that no theory can be established beyond every

possibility of doubt by any finite number of observations. This is so because theories are universal propositions which are intended to express the constant relations between an indeterminate number of specific events, most of which lie in the future. But while the empirical evidence for a theory can never be complete, *some* empirical evidence there must be. This statement implies the proposition that not every state of affairs can be confirmatory evidence for a given theory, so that propositions about possibly observable states of affairs must be specifiable which would contradict the theory. Any theory for which this statement is not true is without empirical content. Laplace did not require God in his *Celestial Mechanics* to explain the motion of heavenly bodies, simply because the hypothesis of God leads to no consequences which are empirically refutable.

But a word of caution must be added. Not all theories are rejected simply because an observed fact seems to contradict some logical consequence of a theory. For any empirically testable consequence which is said to be drawn from a theory does not follow *simply* from the given theory. It follows from the theory *conjoined with* other theories and observational data. It is thus the whole system of our knowledge which is put to an empirical test. Hence an alleged contradiction between theory and observation can be eliminated by making suitable changes in other parts of the body of our knowledge, so that what was initially regarded as a logical consequence from the theory no longer is capable of being deduced from it. Nevertheless, while so-called crucial experiments for a theory are not finally decisive and are only relatively crucial, *in the context of a given set of assumptions* the propositions about possible observations which would contradict the theory must be determinate; in that context we must in principle be capable of deciding whether such propositions corroborate the theory or not. This methodological principle will be shown to play an important role in the discussion of the meaning of probability.

3. There remains one further point in methodology which I wish to make explicit. Every theory about a subject matter involves a selection of phases of behavior within that subject matter, and does not consider the interrelations of all its phases. Moreover, for various reasons, a theory will state only an idealized schema of the relations between the selected phases. These observations lead to the consequence that the confirmation of a theory by experiment is only approximate. Now the degree of approximation which must hold between the consequences of an acceptable theory and the observation propositions is not determined by the theory. The degree may vary for the different situations to which a theory is applied and may even be left unex-

pressed as a tacit rule of inquiry. It is important to note, however, that the degree of allowable approximation is determined by various material considerations, such as the purpose for which the inquiry is undertaken, the kind of activity which the theory is intended to coördinate and foretell, or the character of the instruments by means of which the testing is carried on. In some domains of research, the ideal pursued may be the development of theories for which the degree of allowable approximation progressively diminishes; in other fields the pursuit of such an ideal may be a fatal obstacle to the achievement of the goal of an inquiry. From the point of view of an outsider, the limit of allowable approximation is arbitrary, conventional and "subjective." If such a person were to refuse to accept certain allegedly confirmatory evidence for a theory on the ground that the approximation was not close enough, neither logic nor matters of fact could force him to do so. Such a person would simply refuse to abide by the rules of the game which that special science or special inquiry agrees to follow.

These remarks will be shown to bear upon the interpretation of the meaning of probability, because they are relevant for the interpretation of any symbolic operation which is performed within a theory. Mathematical physics, for example, differentiates and integrates certain functions representing the distributions of material particles; nevertheless, it is safe to assert that the mathematical conditions required for these operations do not obtain for the actual distribution of particles. Similarly, infinite series are employed to calculate magnitudes of various kinds, even though the objects which have those magnitudes would not be regarded as capable of physical decomposition into an infinity of parts. Such symbolic operations upon infinite and continuous manifolds must clearly be supplemented by stipulations about the degree of approximation within which experimental findings will be regarded as corroborating the theory. These operations are effective tools for dealing intellectually and in a generalized way with a set of otherwise unrelated problems; they are so many different *façons de parler* for formulating and translating the invariant relations between what is directly observable. They are not in general "literal" statements about a subject matter, so that some indication must be supplied concerning the extent to which empirical traits may deviate from the idealized schema so that the latter will still serve the specific objectives of an inquiry.

## II

With these methodological principles in mind, I turn now to an analysis of the meaning of probability. Lack of time, to say nothing of lack of competence, does not permit an adequate survey of the in-

numerable contexts in which propositions about probabilities occur. I wish, however, to distinguish five broad types of contexts in which they do occur, consider three analyses of the meaning of the term "probability," and indicate the bearings of the above methodological considerations upon each.

Statements involving probabilities are to be found in (1) every-day discourse, (2) in the field of applied statistics and measurements, (3) within the context of physical and biological theories, (4) in the comparison of theories with each other for their respective degrees of probability, and (5) in the branch of mathematics known as the calculus of probability. Examples of each type of statement will appear in due course, in the discussion of the three major interpretations of probability with which I wish to concern myself. To these I now turn.

The first interpretation is the classic one, associated with the historical development of the mathematical theory of probability. It has been expounded with vigor by the English logician and mathematician De Morgan. According to him, the word "probable" refers to the state of mind with respect to an assertion for which complete certainty or knowledge does not exist. Hence the degree of certainty of a proposition, its "probability," is the degree of belief with which it is held. For certainty has degrees, and all grades of "knowledge," it is claimed, are capable of being quantitatively conceived. It is possible, therefore, to apply the calculus of probability to the degrees or strength of belief, if probability is defined algebraically as the ratio of the number of alternatives "favorable" to an "event" to the total number of equiprobable alternatives. The transition from this definition to the previous one is mediated by the principle of sufficient reason or indifference, according to which two propositions are equally probable if the strength of our belief is equally divided between them.

The second interpretation of probability is professed by certain English logicians like the economist Keynes. According to it, any two propositions are related not only by the relations usually studied in traditional logic, such as implication, but also by a directly intuitable relation called probability. This relation is not analyzable, although it is capable of having degrees. However, while any two propositions will each have some degree of probability with respect to a third, the degrees of probability are not in general comparable or measurable. Hence it is not always possible to apply the calculus of probability in order to explore the implications of compound assertions of probability relations. But whenever the calculus is applicable, the application is carried on in terms of a modified principle of indifference.

The third interpretation of probability is already implicit in Aris-



tote, but has become prominent only within the last century as a consequence of applying the probability calculus to statistics and physics. Its central idea is that by the probability of a proposition or an "event" is meant the relative frequency of the "event" in an indefinite class of events. A more precise statement of this view will be given presently. It is sufficient at this point to emphasize the fact that on this interpretation every statement involving probabilities is a *material proposition* whose truth or falsity is to be discovered by examining objective relative frequencies.

We must now decide (1) whether the meaning of propositions about probabilities in any of the five contexts I have enumerated is adequately stated by any one of these interpretations; and (2) whether any of these interpretations correctly analyzes the meaning of the propositions in *all* the five contexts.

Now it is demonstrable that statements involving the term "probability" which occur in the mathematical calculus of probability, in no way depend upon any of these interpretations. For the calculus of probability is a branch of what is called "pure" mathematics, a discipline whose sole object is to discover whether something follows logically from something else. The premises or axioms of the calculus, as a branch of pure mathematics, are not propositions but *propositional functions*, i.e. expressions containing *free* variable, as in the statement "If  $p$ ,  $q$ , are the probabilities of two exclusive alternatives  $x$ ,  $y$ , respectively, then the probability of  $x$  or  $y$  is  $p$  plus  $q$ ." If we examine this and analogous statements and the operations of the calculus carefully, we discover that the term "probability" is a *free* variable, which is defined only *implicitly* by the axioms of the calculus. As far as the calculus itself is concerned, the free variable may be interpreted in *any* manner whatsoever consistent with the axioms of the system. It may even be possible to interpret the free variable "probability" in each of the three ways suggested above, just as it is possible to interpret the letters  $a$ ,  $b$ , in the formula  $a+b=b+a$ , as integers, fractions, or complex numbers although these are three different sorts of numbers.

The calculus of probability does not therefore determine the specific empirical content of the term "probability" which occurs in its statements. Its axioms may of course be used to define implicitly what probability is, and thus limit the range of possible interpretations of the term. But its primary function is to enable us to discover, given certain initial probabilities, what other probabilities are implied by them. It therefore follows that the use of a so-called principle of indifference *within* the calculus to *define*, for purposes of supplying hypotheses for deductions, the alternatives which are to be treated sym-

metrically, does *not* justify the use of that principle as a criterion for *deciding* which material propositions are "equiprobable" in any non-formal sense of the word.

There thus remain for consideration four types of propositions involving the term "probability." Now I think that when some people assert propositions in every-day discourse, such as "It is very probable he read it in some book," "It is not probable that he could have forgotten me," or "The real existence of Christ is most probable," they mean by "probability" just what De Morgan says they mean. For when we inquire what sort of evidence is believed by these people as relevant for these propositions they can do nothing but reassert their beliefs; while the rapid variation in the degrees of probability which they attribute to propositions makes it plausible to assume that a degree of probability is in some way an index of the "intensity" of their convictions. Moreover, I also think that when some people evaluate theories with respect to their truth, for example when they declare "The theory of evolution is just as probable as the theory of special creation," it is a subjective interpretation which seems to be the correct one. However, those who consistently use the term in this sense assert propositions about probability which have no verifiable consequences, since the implicit predictions which they think are involved in their statements can in no way be justified as logical consequences from them. In spite of the efforts of De Morgan, Stumpf, and others to assign an interpretation to the numerical value of a "probability" when the latter is understood as strength of belief, no unambiguous criteria have been specified for the equality, addition, or multiplication of probabilities. They are therefore not entitled to employ the calculus of probability upon their interpretation of what probability is, because the fundamental operations of the calculus are without any specified content. And finally, this interpretation of probability is completely irrelevant for propositions in applied statistics or physics like "The probability of a male birth in the U. S. is .52," or "The probability of a  $10^\circ$  deflection of an  $\alpha$ -ray passing through a film is  $\frac{1}{4}$ ." As Norman Campbell remarked apropos of the last statement, if anyone proposed to attribute to that probability any value other than that determined by frequency, he would convince us of nothing but his ignorance of physics.

It has been claimed for the Keynes interpretation of probability that it is the only adequate one for most uses of the term. Thus, it is claimed that for propositions such as the following: "On the evidence as to their moral character, it is more probable that witness *A* speaks the truth than witness *B*," "It is probable that Miss *C* would have won the beauty prize if she had entered the contest," or "Relative to ex-

periment *D* the Einstein theory is more probable than relative to *E*," we must have a "rational insight" into the connections between the evidence and the conclusion said to be probable. For, it is alleged, in these cases the probability relation cannot be interpreted in terms of relative frequencies; for no numerical evaluation of the degrees of probability is possible since the relevant statistical information is completely lacking. Hence "probability" refers to a unique, directly intuitable relation between propositions.

I shall examine presently what a frequentist might say to this. I will admit, however, that probability relations are often asserted to hold on the basis of no specific statistical evidence such as the frequency interpretation seems to require. But I do not think this *proves* the existence of such a unique relation of probability which can be "rationally" intuited. In the first place, there are few people who claim for themselves the requisite intellectual faculty for intuiting these unique relations. In the second place, the alleged intuition is not controllable, and there seems no way of corroborating its findings. For the alleged unique probability relation is not definitely localizable, so that agreement both about its presence and degree cannot be obtained among competent students. And in the third place, on Keynes' view a degree of probability is assignable to a *single* proposition with respect to given evidence. But what *verifiable* consequences can be drawn from the statement that with respect to the evidence the proposition that on the *next* throw with a given pair of dice 7 will appear, has a probability of 1/6? For on the view that it is significant to predicate a probability to the single instance there is nothing to be verified or to be refuted. Hence Keynes' view, like that of De Morgan, violates the principle of verifiability required for all statements, and cannot be regarded as a satisfactory analysis of probability propositions in the sciences which claim to abide by this canon.

### III

We must therefore examine the frequency interpretation of probability, to discover whether it offers an adequate account of the types of probability propositions I am considering and whether it is free from the objections which are fatal to the alternative interpretations. It seems to me, however, that the views of De Morgan and Keynes are correct in insisting upon two points, so that a frequency interpretation must be so formulated as to include them. The first is, that probability is not a property of facts or events, but of propositions. It follows that the analysis of the meaning of probability and the consideration of the evidence for probability propositions belong to logic, not to physics or

metaphysics; and indeed I think that at no point in that analysis or consideration is a prior decision required about the universality of causal determination or the presence of absolute contingency. Thus, when we seem to talk about the probability of an event we are simply talking inaccurately although conveniently about the probability of a proposition stating the occurrence of that event. The second point is that probability is not a property of a *single* proposition, but is a relation between propositions. A proposition is either true or false, and is not, as such, probable; it is probable with respect to other propositions. It seems to me, therefore, that a frequency view will not quarrel with Keynes on the ground that "probability" refers to a relation between propositions, but only on the ground of what *sort* of relation it is.

The chief difficulty for the frequentist is to find a formulation for his view, or at least an interpretation of a formulation, which will make it adequate for the sort of situations where it is fairly clear that frequency considerations are relevant. I wish to consider the following one.

Let  $C_1$  be a characteristic, e.g. being a coin with usual shape and construction tossed in the usual way, and  $C_2$  be another characteristic, e.g. falling heads uppermost. Then " $x_i$  is  $C_1$ ," " $x_i$  is  $C_2$ " and " $x_i$  is  $C_1$  and  $C_2$ " are propositional functions whose values are propositions, true or false, when constants are substituted for the variable  $x_i$ . Let  $T_i^n(x_i \text{ is } C_1 \text{ and } C_2)$  be the number of true propositions obtained when the constants replace the variables in the respective propositional functions, where  $n$  is the total number of propositions obtained in this way; and let  $T_i^n(x_i \text{ is } C_1)$  be interpreted in a similar manner. Finally, form the fraction  $F_n(C_1 C_2) = T_i^n(x_i \text{ is } C_1 \text{ and } C_2) / T_i^n(x_i \text{ is } C_1)$ , which will be the numerical value, in  $n$  cases, of the relative frequency with which propositions of the form " $x_i$  is  $C_2$ " are true. If, now, the fraction  $F_n$  approaches  $p$  as a limit as  $n$  increases without limit,  $p$  will be called the probability with which, to speak loosely, a coin falls heads on the evidence that it is "fairly" constructed and "fairly" tossed.

This definition of "probability" incorporates the two important insights of the alternative interpretations already discussed, and adds a feature which they neglect—namely, relative frequency. Consequently, on this "truth-frequency" view, probability is a relation between propositions, but an *analyzable* relation; secondly every statement predicating probabilities is a *material* proposition for which empirical evidence is required; and thirdly, probability denotes a relation between *classes* of propositions, so that a statement about the probability of a single proposition is an elliptic way of asserting a relation between classes of propositions to one of which the given proposition belongs. Since proba-

bility is a fraction, addition and multiplication of probabilities are given intelligible meanings. A calculus of probability may therefore be employed to calculate from certain initial probabilities of propositions the probability values of other propositions related in definite ways to the given data.

I shall take for granted, what is generally admitted, that in such contexts as vital statistics and physics a frequency interpretation for propositions about probabilities is the relevant one. But this discussion of the meaning of probability would be sadly incomplete if I did not touch upon the question whether the formulation of a frequency interpretation I have reported is capable of meeting the serious objections which have been leveled against it. To these objections I now turn.

1. It has been argued that we cannot define probability as a limit of a ratio in the mathematical sense. For if the probability of a proposition *were* such a limit, there would have to be a term in the series studied, *after which* the difference between the limit and the relative frequency empirically found would be less than any preassigned magnitude. But if there were such a term for a given preassigned magnitude, it would follow necessarily that the empirical frequencies could not deviate from the limit by more than this magnitude. This, however, contradicts well established theorems in the calculus of probability.

This objection seems to me to have a point only when we are dealing with what by some writers are called "normal" series, to which alone Bernoulli's theorem is applicable. It loses all force for a series which exhibits a certain kind of internal regularity, e.g., the series of numbers 1, 0, 1, 0, 1, 0, etc. In the second place, as Von Mises has shown, for "normal" series the objection fails to distinguish between the probability that a certain sequence of events will *occur* in a given series and the probability that such a sequence of events will occur at a *definite place* in a series. The latter probability involves not one series but a *whole class* of them, so that a whole set of preassigned magnitudes is required and not only one such magnitude. But in the third place, whatever force the objection has is directed against the dialectical elaboration of probability in terms of the calculus of probability. Now the limit definition of probability is required to develop such a calculus consistently and at the same time to find a way of formulating empirical frequencies so as to be amenable to convenient calculation. Nevertheless, as has already been indicated, the definition has to be supplemented by indicating the degree of approximation which would be allowed in practice between the empirical frequencies discovered and the theoretical limit stipulated. As long as the empirical relative frequencies remain within approximately assigned intervals, it is con-

venient to select *one* of the values which the empirical ratios take on within this interval, and to treat it, for the purposes of calculation, as the mathematical limit of the ratios. This assumption is permissible because it leads to no contradictions, and is advisable because of the dispatch it introduces into the mathematical operations. Since the range of allowable oscillation of the ratios is agreed upon on extra-logical grounds, the range as well as the limit may both be altered with the progress of inquiry. Hence even apart from the acute observations of Von Mises the alleged contradiction could always be obviated by conveniently altering the value of the limit. I think therefore that one virtue in this objection consists in calling our attention to the conventional moment in the value assigned to a probability.

2. A second objection is directed not only against a limit definition of probability, but against *any* frequency interpretation of the term. I shall state it, however for the limit definition. How can we ever discover the probability value of a proposition on given evidence, it is objected, if this value is defined as the limit of an infinite sequence of ratios? For we do not, in general, know the law of the sequence, and we can never examine more than a finite number of its terms. Hence the value of a probability is a sort of "unknowable," so that this definition of probability cannot be a correct analysis of what we mean in making judgments of probability.

A two-fold answer may be offered: In the first place, while it is true that we can examine only a finite number of terms in an empirical series, we can employ the empirical ratios as hypotheses for the "true" probability value of the infinite series. These hypotheses are to be tested in the usual way, by comparing their logical consequences with the ratios subsequently observed empirically. And in the second place, a probability value may be deduced from some general theory already established, instead of being obtained from observation of a statistical series. For example, the probability of a "fair" coin falling heads uppermost may be computed by the aid of theoretical mechanics, although in this case the calculated probability is once more a hypothesis to be tested by empirical frequencies.

Before elaborating these answers I think it is necessary to note an important objection that is made to both of them. Suppose we entertain the hypothesis that the probability of getting a head with a coin thrown in the usual way is  $\frac{1}{2}$ . This hypothesis must then have determinate consequences, in accordance with the principle of verifiability discussed above. But suppose that in a thousand throws heads turn up 900 times. Has the hypothesis been refuted? It is well known, however, that this empirical result is not incompatible with the hy-

pothesis of  $\frac{1}{2}$  as the probability, since, indeed, this hypothesis requires us to expect it; for that hypothesis means simply that in an *indefinitely* long series the proportion of heads will be approximately  $\frac{1}{2}$ , and does not therefore exclude a preponderance of heads within a finite segment of the series. It seems, therefore, that the hypothesis of  $\frac{1}{2}$  as the probability, like the hypothesis of a Providence, has no *refutable* consequence, and is without empirical content. It is no answer to this observation that no hypothesis can be *completely* verified. For the criticism doesn't challenge the hypothesis of  $\frac{1}{2}$  as the probability on the ground that it is not capable of *complete* confirmation, but on the ground that, in terms of the hypothesis itself, it does not seem capable of refutation no matter *what* the empirical findings are.

It seems to me, however, that this objection is fatal only if the frequentist fails to introduce the degree of allowable approximation into his predictions. For it is obvious that in practice we do decide, on the evidence of empirical frequencies in final series, whether the assumption we have made as to the value of a probability is corroborated or not. Thus, if a coin were thrown a thousand times and the head came up 490 times, we would regard this as supporting the hypothesis that the probability of its coming up is  $\frac{1}{2}$ , where the hypothesis has been suggested by observing other finite series of throws; if it came up 520 times we would usually still regard this as confirmatory evidence; but if it came up only 400 times we would normally reject the hypothesis, suspect the coin was loaded, and propose a different value for the probability. We proceed in this manner because we have in mind a degree of allowable approximation, in this case lying somewhere between a deviation of twenty and one of a hundred. That we do not always explicitly define this degree is not important. We cannot specify this degree once for all, since it is a function of the specific context in which the coin is thrown. What is important, to my mind, is that there is a tacit acceptance of *some* degree of allowable deviation, however vaguely we may formulate it to ourselves.

But I think something further can be said about the way the specific context of inquiry controls this degree of allowable deviation, and about the way in which the testing of hypotheses about probabilities is conducted. Propositions about probabilities are not isolated propositions in the body of our knowledge. The evidence for them comes not merely from an examination of statistical frequencies, but also, and sometimes exclusively, from various theories and other data. Consequently, in the above case, if we have reason to believe that the coin is not loaded and is "fairly thrown," in any finite segment of an endless series a larger degree of deviation from the hypothetical frequen-

cies will be allowable than if we did not possess this information. On the other hand, if a man is gambling with a limited amount of money, he will generally impose a smaller degree of permissible deviation from the hypothesis he entertains for the relative frequencies. Thus, although we cannot fix once for all the number of throws within which the hypothesis about the probability would be taken as sufficiently corroborated, in practice such a number is roughly indicated.

It must also be stressed that the method of rational inquiry is a self-corrective one, and in general we place greater reliance upon our rules of procedure and "long-run" results than upon particular conclusions obtained. Thus, suppose that in the case where we obtain 400 heads out of a thousand throws with a coin we are led to entertain the hypothesis of  $2/5$  for the probability of getting a head. It may be the case that for this particular coin the "true" probability is in fact  $\frac{1}{2}$ , so that the hypothesis of  $2/5$  is false. Nevertheless, it would not be irrational to adopt the latter hypothesis in this instance, if it were the case that when we continually formulated hypotheses on evidence in the manner indicated, we did hit upon a good approximation to the relative frequencies more often than not. Indeed, while we are not in the position to assert that the empirical relative frequencies do approximate to a limit, nevertheless if they do we are bound to discover this approximate value by a repeated and systematic correction of the hypotheses suggested by the empirical samples we continue to examine.

#### IV

According to the frequency interpretation of probability it seems as if we ought to be able to associate a definite numerical value with every statement about probability. But it must be pointed out that the evidence for statements of probability may often be inadequate, because both statistical and theoretical information may be lacking. In such while it still may be true that what we *mean* by probability is stated by the frequency view, for lack of relevant evidence we rely on general impressions and "hunches." Thus, for the proposition "It is probable on the evidence that witness *A* speaks the truth," we do not possess any means for assigning a definite numerical value to the probability. It does not follow, however, that a frequency interpretation is illegitimate. For what may be meant by this statement is that the relative frequency with which a regular church-goer tells lies on important occasions is a small number considerable less than  $\frac{1}{2}$ . For many purposes we do not require an actual numerical value for the probability, since in some contexts an indeterminate value which is greater (or less) than



$\frac{1}{2}$  is sufficient; and although we may lack adequate statistical material to support such statements, we may nevertheless possess considerable general experience to corroborate them. In these contexts I would admit that the more precise formulation given above is not a good picture of the meaning of probability statements; and that a frequency interpretation is satisfactory only if we take care not to define probability too rigorously.

Nevertheless, in the light of the preceding I think it is at least plausible that in the first three contexts enumerated earlier, a frequency interpretation of probability is a workable one, although whether it is satisfactory for any given instance of a probability proposition can be decided only by examining the instance itself. The remaining question I wish to touch upon is whether statements about the probability of theories can also be interpreted in the frequency sense.

Since statements about the probability of a proposition are material statements for which, in the light of the preceding, the evidence must be judged as incomplete, such statements are hypotheses about the probability in question. It is therefore not surprising to find statements like the following: "It is probable that the probability of getting heads with a coin is  $\frac{1}{2}$ ," and it is natural to ask whether in the first occurrence of the term "probable" means the same as in its second occurrence.

There is a way, I believe, in which both occurrences of the term "probability" in this statement can receive a frequency interpretation. Suppose there are an indefinite number of coins  $a$ ,  $b$ ,  $c$ , etc., for each of which we seek the probability of getting heads by repeated tosses; we then would obtain a theoretically endless "square array" of propositions. Suppose further that after say a thousand trials with each coin, we formulate the series of propositions: "The probability that coin  $a$  falls heads is  $\frac{1}{2}$ ," "The probability that coin  $b$  falls heads is  $\frac{1}{2}$ ," etc. Each proposition is a hypothesis about the respective coin, and requires to be tested in the usual ways. Now suppose some of these hypotheses were confirmed by continuing the series of throws with the corresponding coins and some were not, but that nevertheless the ratio of verified hypotheses to the total number exceeds  $\frac{1}{2}$  say. We may express this by saying that on the evidence that these hypotheses have been tested to the extent indicated, the statement: "The probability that coin  $x$  falls heads is  $\frac{1}{2}$ " where  $x$  is *any* coin, has a probability greater than  $\frac{1}{2}$ . It seems to me, therefore, that in *some* cases where hypotheses are said to be probable, it is possible to interpret the probability of hypotheses in a frequency way.

But is it *always* correct to interpret such statements in this way? I think there are several cogent arguments for denying this.

1. It is possible to interpret the probability of *singular* propositions, like "This coin falls head uppermost" in a frequency manner, because singular propositions are *values* of propositional *functions* and because we can define the expression "the truth-frequency of a propositional function." But, it is urged, we cannot in general regard a theory as a *value* of some propositional function, and in any case we cannot attach a clear sense to the expression "the truth-frequency of a propositional function for which a theory is a determinate value." For consider such a complicated theory as Newtonian mechanics. Is it possible and is it practicable to regard this theory as some value of a propositional function? And is it really helpful to talk about the truth-value of this theory in any sense analogous to the way in which we discuss the truth value of the proposition "This coin falls heads uppermost?" It will follow that if the answer to these questions is in the negative we cannot assign a frequency meaning to a statement that the Newtonian theory is probable on given evidence.

2. It is sometimes thought that we can assign a numerical and therefore a frequency probability to a theory under the following circumstances. On the hypothesis that theory *A* is true the probability of an empirically confirmed proposition *p* is 1; on the hypothesis that theory *B* is true, the probability of *p* is  $\frac{1}{3}$ . Hence, it is claimed, *A* is three times as probable as *B* on the evidence that *p* is true. But this argument must be rejected by a frequentist on the ground that it uses Bayes' theorem in the form in which it tacitly employs the assumption that the *antecedent* probabilities of *A* and *B* are equal. Such an assumption is incompatible with the central thesis of the frequency view. The most that a frequentist can claim is that by adopting theory *A* he is employing a system of inferences which would lead him, *via* the theory, to empirically false conclusions not oftener than approximately once out of three times.

3. This last remark may be thought to provide a clue for interpreting in a frequency way the probability of theories. It has been suggested that such statements mean that the logical consequences of a theory which may be approximately confirmed by experiment are true with a certain relative frequency for the series of *all* the logical consequences of the theory capable of experimental testing. This suggestion, however, does not seem to be a way out, for according to it we would say that the probability of the Newtonian theory is  $\frac{4}{5}$  if every fifth consequence of the theory were materially false. But in such a case the theory would ordinarily be rejected as false, and not accepted as highly probable.

4. And finally, it may be urged that what we mean by the proba-

bility of a theory is the ratio of its *actually* verified consequences to the total number of its *possible* consequences. In general, however, since this ratio would have the value zero, this cannot be taken as the measure of the probability of a theory.

It seems to me therefore that in general statements about the probability of theories do not refer to relative frequencies in any obvious way, although for some theories which are not too complex it is possible to provide a frequency interpretation for propositions about their probabilities. I do not see in what way it is possible, or for that matter in what way it would be useful, to compare, say, the "probability" of the gene theory in genetics on the evidence for it, with the "probability" of the relativity theory on the evidence for the latter, although on a frequency interpretation such comparison should be significant. I do not reject the frequency interpretation for statements about the probability of theories, as is sometimes done, on the ground that there is an essential difference between universal and singular propositions because of an alleged difference in the logic of verification required for them. Nor do I believe that the acceptance or rejection of a theory is a completely arbitrary matter, or that the evidence for one of two alternative theories may not be more complete or satisfactory than for the other. This is a matter which requires an independent study, and would lead, I think, to another meaning of the term "probability" into which frequency considerations enter in ways different from the way they enter the frequency view here discussed. But I do think that it is not very illuminating to place the interpretation of all statements about the probability of theories upon the Procrustean bed of the frequency view I have considered. For while there are certain rough analogies between the way the term "probability" is used in the context of statements about theories and its use in other contexts, the differences in this case seem to me to outweigh the similarities.

I conclude, therefore, that the term "probability" is not a univocal term, for it has different meanings in different contexts. However, the frequency interpretation, when properly qualified, seems to be the most satisfactory one for analyzing the meaning of the term in the contexts of every-day discourse, applied statistics and measurement, and within many branches of the theoretical sciences. Furthermore, some statements about the probability of hypotheses can be interpreted in a frequency manner; but I do not find sufficient grounds for maintaining that such is the meaning of probability in statements about the probability of complicated theories like the corpuscular or wave theories of light.

## DISCUSSION\*

After an impartial survey of the various contexts in which the term probability is used, the speaker reaches the conclusion that the frequency interpretation is the most satisfactory in rendering the *central* meaning of the term. This result, arrived at from the avenue of methodological analysis, must be pleasing to those who are accustomed to handling probabilities in practical calculations, for they almost invariably acquire the attitude that the only *possible* meaning of probability is the statistical one. While this position is doubtless dogmatic, it has been strengthened enormously in recent years by a new development of physical thought to which Professor Nagel has indirectly referred in his allusion to theoretical physics. I mean the subject of quantum mechanics. It seems to deserve a place in the discussion of probability because it renders the statistical or frequency point of view well nigh universal.

If the fundamental thesis of quantum mechanics is correct, *all* physical observations form a probability aggregate, that is, a set of data to which the probability calculus can be applied. The essential difference between this physical doctrine and the older statistical theories lies in the claim to universality made by quantum mechanics. For, while the older theories admitted their incompetence in large fields of physical thought, such as dynamics and electromagnetism, quantum mechanics shows signs of success in handling *all* physical phenomena. And if, as is frequently supposed, the data of all exact empirical sciences are basically physical, we are confronted with the possibility that the entire physical world ultimately resolves itself into a set of events joined merely by the rules of the probability calculus. The interesting point in this connection is that quantum mechanics *requires* the frequency interpretation of probability, and therefore imposes it on physical experience in general.

To give a definite physical example let us consider any system, say, an atom of hydrogen. All that we can possibly know about it is summed up in the specification of its state function. Being in possession of all the elements of knowledge which describe its state, we are nevertheless in general unable to say with precision what the value of its energy content in a single observation will be. The only feature capable of prediction is the relative frequency with which each possible energy value will occur. There is no sense in which a probability statement of this sort can be connected with the views of De Morgan or of Keynes.

It must be admitted, of course, that arguments like the preceding, which dwell on the mere prevalence, however general, of a single probability interpretation do not in strict logic rule out other meanings if they occur in scientific discourse. However, they do raise the question as to the desirability of reserving the word probability, in its technical usage, to express those ideas which it seems most generally to convey. I do not suggest that phrases like "it will probably rain tomorrow" should be banished from refined discourse. But it might well be a gain if logicians, by common agreement, were to take the same attitude toward such phrases as the physicist does toward the wholly proper common application of the term work. Words are but tools which may be handled in different ways according to the results desired, but when a definite purpose is to be achieved, their use should be definite and unequivocal.

According to Professor Nagel, a probability is the limit of the relative frequency with which a propositional function is true. I should like to ask the

\* Condensed from the prepared discussions of Professor Nagel's paper.

speaker if he regards this formulation as complete. Since it makes no reference to any particular *order* in which the constants are to be substituted into the propositional function it permits their arrangement at will. Thus, in the simple case of the alternative of heads and tails, one might arbitrarily select all tosses which appear heads uppermost. But as we assume the availability of an infinite number of these, the limit of the relative frequency of heads would be one. If, on the other hand, we had chosen regularly two heads and then one tail, as is perfectly feasible, the probability would have been  $\frac{2}{3}$ .

The trouble here has nothing to do with the mathematical existence of the limit; the difficulties encumbering that point have in my opinion been adequately resolved by the speaker. It arises from the fact that the truth formulation of the frequency theory presupposes merely any sequence of propositions, but not an ordered sequence. It admits sequences with too much internal regularity, like alternations of heads and tails, or arrangements like the recurring decimals of the fraction  $\frac{1}{7}$ . Such aggregates are foreign to probability rules, as would be intuitively clear to any one confronted with the task of defending such a sequence as the result of a game of chance. What we encounter in actual practice is usually *not* a set of propositions devoid of arrangement, but an ordered set of events, in connection with which *frequency* means *frequency of occurrence* (rather than of truth). If now we augment the probability definition, as given, by the statement that the limit shall be insensitive to a "blind" selection of elements from the set, it becomes complete. By blind selection I mean the following: Starting with the ordered sequence, we select elements by a *preassigned* rule, that is by a rule which does not regard the property of the element in question. For instance, from the aggregate of tosses of a coin, we might select every second throw, or every throw whose ordinal number is a prime, but not every third head, etc. We then demand that the aggregate formed from the elements thus selected shall possess the same limiting values of the relative frequencies. If this demand is satisfied, we speak of probabilities.

Now, with this detail out of the way, it seems profitable to survey the various probability interpretations in the light of the question: When does a quantitative application of probability notions lead to correct answers, and when does it not? In other words, upon what type of aggregate (propositions or events) may one legitimately operate with the probability calculus? Closer examination would show that only a frequency theory can give the answer, and the answer would be that just outlined. It is obvious, therefore, that any theory which identifies probability with truth value or intensity of belief labors under a two-fold disadvantage: first, it is incapable of specifying quantitative probabilities at all, as was clearly shown by the speaker; second, it is incompetent to name the conditions under which it may legitimately proceed. The last statement means that unless one adopts a frequency point of view, one is unable to tell when the quantitative use of probabilities will land one in error.

Since the use of probabilities in connection with *theories* is not interpretable on the basis of a frequency view, and is therefore subject to uncontrollable fallacies, I should simply urge that this usage be regarded as unscientific. Perhaps substitution of the term "truth value" in that context might be recommended. Or else one might distinguish between "probability of truth," whatever truth may mean in a given connection, and "probability of occurrence."

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Professor Nagel proposed to define probability in terms of frequency. The question arises, however, whether, in terms of frequency, any meaning can be assigned to the expression "the probability of an event that occurs only once." Suppose, for instance, that my life hangs on my answering correctly the question whether the card which I now draw from a pack is a spade or is not a spade. It would commonly be said that *that particular drawing* will *probably* not be a spade. But to say that "probably" here means that if *several* drawings were made, the cards drawn would, more frequently than not, be other than spades, is, in effect, only to predict what would occur *if not only that one drawing, but several drawings, were made*; and this seems clearly irrelevant to the question what probability means when *that one drawing only* is referred to. And to say that we are able to speak at all of the probability of that drawing only in so far as that drawing is representative of a class is only to raise instead the question what it means, to say that *that one particular drawing probably* is representative of a class 3 out of 4 cases of which, on the average, turn out not to be spades,—a question which seems no easier to answer in terms of frequency.

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The frequency interpretation of probability, as Professor Nagel has shown, appears to be the most satisfactory one in most of the senses in which the term is used. However, there are situations in which statements to be made involving uncertainties seem to require a logical approach different from that of a straightforward application of the notions of classical probability. Consider, for example, Professor Nagel's discussion of the statement: "It is probable that the probability of getting heads with a coin is  $\frac{1}{2}$ ." I cannot agree with his frequency analysis as a solution of this problem. If the possibility of a continuum of values of the probabilities in the neighborhood of  $\frac{1}{2}$  is admitted it appears paradoxical that he should arrive at the conclusion, "The probability that coin  $x$  falls heads is  $\frac{1}{2}$ ' . . . has a probability greater than  $\frac{1}{2}$ ." This means that the probability is greater than  $\frac{1}{2}$  that a number which can take on a continuous range of values will take on a preassigned value. The difficulty is not in the meaning of the "probability of getting heads," but in the frequency interpretation of the *probability* of the "probability of getting heads." This problem seems to depend on a procedure for its solution different from that of a direct application of classical probability theory. In view of recent advances in uncertain inference by R. A. Fisher, J. Neyman, E. S. Pearson and others, a more satisfactory analysis and solution of this problem is as follows:

Assume the true probability of getting heads with a given coin to be  $p$ . Of  $n$  tosses of the coin suppose  $m$  are observed to be heads. By deductive methods, the probability of getting  $m$  heads is found to be  $\{n!/m!(n-m)!\}p^m(1-p)^{n-m}$ . We now devise a function  $F$  of  $m$  and  $n$  and associate values which  $F$  can assume, with intensity of tenability, or degree of confirmation of the hypothesis that  $p$  is the probability. To effect this association, we must have some method of estimating  $p$  from  $m$  and  $n$ , since, in this problem, we are inferring the value of  $p$  from the data  $m$  and  $n$ . The estimate which is made of  $p$  must satisfy certain self-evident conditions, among them being that it must have an expected value equal to  $p$ , and it must estimate  $p$  with minimum error. A method which satisfies these conditions and certain other important ones is furnished by the method of maximum likelihood. Once we have found  $F$ , which, in this example, can be taken as  $x = m/n$ , the optimum estimate of  $p$ , we make the hypothesis that  $p$  is the

probability and by the classical theory of probability we find how the probabilities associated with the various values of  $F$  will be distributed. We now choose a set  $S$  of possible values of  $x$  such that the sum of their probabilities of occurrence is a preassigned number  $\epsilon$ ; then if  $x$  falls in  $S$  we reject the hypothesis that  $p$  is the probability. The actual determination of  $S$  is made in the light of alternative hypotheses. It is selected on the principle that, in the long run, we should reject our hypothesis in not more than a fixed percentage ( $100\epsilon\%$ ) of cases when it is true, and that we should accept it as seldom as possible when it is false (that is, when one of the alternative hypotheses is true). For the given number  $\epsilon$  and for each value of  $p$ , we find the largest  $x_1$  for which the probability that  $x \leq x_1$  is less than or equal to  $\frac{1}{2}\epsilon$ ; likewise the smallest  $x_2$  for which the probability that  $x \geq x_2$  is less than or equal to  $\frac{1}{2}\epsilon$ . Then if  $x$  falls in the region between  $x_1$  and  $x_2$  corresponding to a given value of  $p$ , this may be declared confirmatory evidence for the given value of  $p$ . Otherwise,  $p$  will not be accepted as being a tenable value of the probability of the coin falling heads. If we take the region generated in the  $p$ - $x$  plane by taking the interval from  $x_1$  to  $x_2$  for all values of  $p$  from 0 to 1, we have an area called a "confidence belt" with a "confidence coefficient" of  $1 - \epsilon$ . From the given data  $m$  and  $n$  there will be formed a certain value of  $x$ , say  $x_0$ , and there will be a set  $k_0$  of possible values of  $p$  such that if  $p$  is any member of  $k_0$ , then  $x_0$  would be in the region of confirmatory evidence; if outside,  $x_0$  would be classed as contradictory evidence with confidence coefficient  $1 - \epsilon$ . Since the probability that  $x$  should be in the region of confirmatory evidence is  $1 - \epsilon$  (for any given value of  $p$ ), we can make the objective statement that a given value of  $x$  will be confirmatory evidence for any of our admissible hypotheses in which  $p$  has a value in  $k$ . We can condense the statement to the following one: If  $m/n = x$ , the *fiducial* probability is  $1 - \epsilon$  that  $p$  has a value in  $k$ . This is not probability in the classical sense at all, but it seems to be an adequate technique for making inferences about the value of  $p$  from those of  $m$  and  $n$ . The method is somewhat more general and can be applied to problems involving regression coefficients, variances, etc. The important thing to be observed is that we have adopted a rule in which we invariably reject the hypothesis in a certain proportion of cases in the long run, but have chosen the confidence belt so as to minimize the error of rejecting the hypothesis when it is true by maximizing our confidence that one of the alternative hypotheses will be true when the hypothesis is rejected. There is a certain amount of classical probability in the process but it appears more as a tool than as the essence of the method. In the more complicated hypotheses in which inferences are to be made relative to several quantities simultaneously the confidence belt idea is still to be explored. A procedure based on the principle of likelihood has been developed for the more complicated hypotheses which are essentially what Professor Nagel has called theories. As Professor Nagel has implied in the last two paragraphs of his paper, the structure of the argument for making inferences concerning the truth of the more general hypotheses, or theories, cannot be a direct probability argument in the classical sense. As far as the theory has been developed at present, it appears that such an argument would have to proceed along the general lines outlined in the simple coin-tossing problem.

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## SOME USES OF STATISTICS IN EXECUTIVE CONTROL\*

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I SHALL take the term "executive control" to mean the continuous application of directive and regulative decisions and acts to the managerial phases of a business. Executive control is concerned with both the determination of policies and the fulfillment of administrative functions within the framework of the policies established. Both require constant attention to what is happening within the business itself and also outside it, in order that the changes and adjustments which continually become necessary may be made intelligently, promptly, and with coördination.

The concept of executive control as involving never-ending watchfulness, study and analysis, leading to appropriate decisions and actions,—this concept is the one upon which the following discussion is predicated. Business is, and must be, carried on from day to day in a changing environment, each day bringing its particular problems and requiring its minor or major adjustments.

Now, viewing executive control from this realistic, if somewhat prosaic, point of view, what are some of the uses of statistics in such control? To illustrate them by covering a variety of business fields would be impossible within the limits of this paper. It therefore seems best to consider a single field in one industry.

In the automobile manufacturing business the scheduling of production obviously is a problem of prime importance. This problem is complicated by the impossibility of predetermining how many automobiles the public will buy in the course of a given year. Furthermore, no manufacturer can forecast accurately what proportion of the total business he will obtain. The history of the industry records frequent changes in the overall rate of demand and in the relative attractiveness to the public of the various makes of cars, not only from year to year but even within a single year. Clearly, therefore, there is unavoidable uncertainty as to what any manufacturer's ultimate production requirements will prove to be for any model year. Moreover, an automobile manufacturer does not produce a single, standardized product. He must offer the public cars in various body types and colors, and

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usually in more than one wheel base size; and the consumer demand for these various combinations of wheel base, body type, color, etc., is unpredictable very far in advance.

The problem of scheduling production is further complicated by the fact that research is continually resulting in improvement of the product and that annual model change is the practice of the industry. The number of cars produced by a manufacturer during the model year must not be allowed materially to exceed or fall short of the number the public will buy at a price which will return a profit. An insufficient supply to meet the consumer demand means a loss of business, while any stock remaining on hand when new models are introduced becomes unsaleable except at a considerable reduction in price.

But there are other important purposes to be achieved by effective production regulation than merely the manufacture of the right number of cars during the model year. To secure the greatest practicable utilization of equipment, to maintain the quality of the product, and to extend the maximum annual earning power to the mass of employes, it is necessary to have as nearly level a rate of factory operations as is feasible and to keep as nearly constant a labor force as possible. Clearly however, there is no way of crystallizing the problem of so regulating production and employment and of affording a definite basis for administrative planning to that end, unless there is maintained at all times an ultimate production requirements figure to tie to. This does not mean, however, that such a figure ordinarily can be established at the beginning of the model year and be allowed to stand unchanged throughout the year, since an estimate of consumer demand made at the beginning of the year can only be a provisional one.

If the ultimate requirements could be known, the attack on the problem would, of course, be greatly simplified. Inability to know them accurately, however, does not remove the necessity of applying the best judgment possible and arriving at the most reasonable estimate or assumption which can be made. Although the figure arrived at may, and almost inevitably will, have to be modified from time to time during the model year, as the indications of the size of the consumer demand become clearer, such a figure must constantly be kept in mind and conscientiously applied, if the interrelated problems of production, employment, and utilization of equipment are to be dealt with in a reasoned and commonly understandable way. Without such an estimate of the production requirements for the model year, no one could judge the relation of a proposed current rate of production and employment to the probable subsequent average rate. And unless changes are promptly made in the estimate, as statistical and other evidence

indicates the erroneousess of the figure, the changes which eventually will have to be made in the rate of production and employment will be magnified.

Constant vigilance therefore is necessary, in order to detect as quickly as possible changes in the seasonally adjusted rate of consumer demand, so that needed changes in production schedules may be made promptly. But how can the rate of consumer demand be gauged? Obviously the first step must be the collection and tabulation of statistics of the sales of cars to consumers. In the earlier years of the industry such statistics were not available. Since 1922, however, the several car divisions of General Motors have been obtaining from their dealers regular ten-day reports of actual deliveries of cars to consumers and of stocks in dealers' hands, and since 1924 these data have been constantly used in an endeavor to effect intelligent regulation of production and employment.

The measurement of the seasonal variation of car deliveries to consumers naturally has been an important statistical problem. Year after year, as additional data have become available, this problem has been reviewed anew in an effort to arrive at more accurate seasonal variation indexes. As time has gone on, occasional sharp fluctuations have appeared in the deliveries figures, which quite obviously were not caused by either seasonal or cyclical influences but were due to other causes. These movements almost invariably have been attributable to some known special condition, such, for example, as a retail sales campaign, a price reduction or a price increase, or a shortage of cars in the field. Naturally, in the periodic reviewing of the question of seasonal variation, these special, peculiar movements have been discounted or actually thrown out of the statistical series when calculating revised indexes of seasonal variation.

It became apparent that human memory could not safely be trusted to recall at future dates the causes to which these peculiar movements were attributable. The practice was therefore begun of keeping a brief chronological record of the events or special conditions which were known or believed to have distorted the deliveries data. We were convinced that it was not enough to know what the statistics said, but that it was necessary also to understand as clearly as possible why the statistics said what they did. So we have tried constantly to question the data, asking why? why? This query, of course, has involved the recurrent question, how good are the data themselves?

In addition to periodical reports of deliveries of new cars to consumers, which are now obtained by all the principal automobile manufacturers from their dealers, the industry has had available since about

1925 comprehensive data of the monthly registrations of new automobiles, not only for the United States as a whole but for the several states and counties. These data are obtainable for individual makes of cars and even for some separate model series of the same make. From such data it is possible to make price group analyses and to ascertain month by month what proportion of the registrations of each price group is obtained by each make of car in that group. The manufacturer is thus able to see what changes are taking place in his competitive position and to ascertain how consumer preference may be shifting from one price group to another.

As I have already indicated, a continuous problem of estimating the size of the model year's consumer demand for the particular product is involved in the problem of scheduling production so as to maintain as nearly level a production rate as is feasible and to keep as constant a labor force as possible. A far from satisfactory production and employment condition may be rendered unavoidable by important unforeseen changes in consumer demand for the particular product; but the effects of such changes upon production and employment would be worse if there were not this constant endeavor to gauge consumer demand and to detect changes in its rate promptly, and if production scheduling did not concern itself with the requirements for the model year as a whole.

In dealing with this continuous problem of estimating future consumer demand, statistics and statistical methods have a highly important place, but they are not the sole determinants. A variety of non-statistical factors also must be considered. The executive who has intimate knowledge of the industry and of the particular business within the industry, who knows the quality of the dealer organization handling the product, and whose day to day experience has given him a sensitiveness to changing conditions, will be likely to use the statistics more intelligently and to greater advantage than one not so endowed and so experienced. If in addition he acquires an interest in the statistics themselves, in their quality and treatment, they will have a fuller meaning and a greater usefulness for him. One of the most important uses of statistics in executive control, therefore, is the frequent, regular examination by the executive of pertinent statistics which he either understands thoroughly or about which he is willing to make himself thoroughly informed. There are such executives, and, in dealing with them the statistician does not indulge in elaborate, carefully qualified reports, but sits down as with another intelligent (but not too technical) statistician and talks things through, gaining as well as giving enlightenment.

This discussion of what is popularly termed production control has had two purposes; namely, to illustrate some of the kinds of statistics required, and also to bring out the fact that problems of executive control are in the main constantly recurring ones—problems primarily of frequent, prompt adjustment—rather than occasional great and dramatic problems, culminating in the necessity for some piece of masterly strategy or epoch-making planning. As Arch W. Shaw said years ago, “business changes too quickly for the solution of to-day to be of much service to-morrow.”

In the automobile industry, and in other industries as well, the most carefully and conscientiously made estimate of the year's production requirements must be subject to recurrent modification, and the scheduling of production and employment accordingly requires frequent minor or major readjustment. The greatest use of statistics in executive control in this field will therefore be in helping promptly to detect and understand changes actually occurring in conditions, and at times to foresee or intelligently guess the nature and importance of changes which are only beginning to take place or which may even be only impending. In such a highly competitive industry as this, and in which annual model changes make surplus stocks of old model cars unsaleable except at a loss, promptness of adjustment, not only with respect to production, but in numerous other directions as well, is more necessary than in some other industries. Such adjustment cannot always wait for definitive statistical evidence, although there is constant effort to secure frequent and promptly compiled data.

In General Motors the recognition of the need of statistics as nearly up to date as possible has resulted in the regular compilation of such data as daily summary statements of working capital position; daily factory expense reports; daily production and shipment reports; daily telegraphic reports from the branch offices of General Motors Acceptance Corporation on car purchases financed on the time payment plan, made available in consolidated form the day they are received. Other types of statistics obtained at somewhat less frequent regular intervals are the ten-day reports by dealers of new car sales and stocks; similar ten-day reports of used cars sold to consumers, used cars taken in by dealers, and used car stocks in dealers' hands. These are illustrative of the statistical basis which has been, and still is being, developed in order to facilitate intelligent operating control. In General Motors—and it is true of other businesses as well—there has been an insistence from the very top of the organization on getting the facts, so that we might, to apply Descartes' picturesque phrase, “be clear about our actions, and walk surefootedly in this life.”

The sooner we come to a realization that business management is a complicated series of undramatic processes, the sooner we shall understand that there is no royal road to business planning or to administrative control. Many persons inexperienced in business apparently fail to see that management must concern itself not only with the larger matters of planning and policy determination, but quite as importantly with a multitude of interrelated daily problems of adjustment and control.

In the everyday use of statistics in business, complicated statistical methods rarely are necessary and always are to be avoided if possible. Simplicity of treatment and presentation is a requisite in the making of statistics useful in executive control. This does not imply that ignorance of the more involved statistical methods is a good thing. The more the statistician knows of methodology the better, provided such knowledge does not make it impossible for him to use simple methods and to realize that he is living in a practical, changing world, in which common sense and time are valuable things.

And let us recognize that neither statistics nor the statistician can ordinarily give the executive the final answers to his problems. But they can help him to reach these answers. If we think of statistics as aids in executive control and neither as ends in themselves nor as marvelous tools whose use makes business management an easy and simple thing, we shall have a more just appreciation of how they can be made most useful.

## BASES OF CONTROL FOR INDUSTRIAL OPERATION\*

BY FAIRFIELD E. RAYMOND  
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**S**TRAIGHT thinking is a prerequisite to all decisive and successfully aggressive action. What does this mean to the business executive who is continually faced with the task of making decisions?

In the first place it would naturally require that he be constantly informed upon changing economic conditions, the progress of the enterprise in its own field, the effectiveness of the management concerned with each phase of the business and the best operating practice. In the second place, however, it requires the exercise of judgment, a keen sense of values and an understanding of what is best in view of impending circumstances.

Experience and business acumen are important guides in the direction of the course of business; however, what criteria are available for executive decision in effectively relating the agencies of production essential to industrial operation? Here lies an opportunity for the engineer to supply the business executive with that fundamental picture of the nature, relationship, and behavior of all contributory factors under varying conditions which will permit of more precise control. To facilitate judgment, this basic knowledge should be reduced to practical standards of performance that mark the most efficient or economical state of operation.

In giving thought to the economic balance of all factors, the economics of alternatives, or the economic cross over point between income and outgo, the work of the engineer is in contrast to that of compiling statistics, of preparing financial and accounting statements, or of budgetary procedures. As a result of this essentially different approach, in what way can the engineer contribute to a greater insight to the best proportioning of the money, men, methods, machines, and materials, employed by industry?

Taking up first the question of *methods* of production, what quantities of a certain article should be processed when conditions require manufacture for stock?<sup>1</sup> If lots of large quantities are processed infrequently the inventory cost will be high; if quite small lots are processed

\* Revision of paper delivered at the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 31, 1935.

<sup>1</sup> See F. E. Raymond, *Quantity and Economy in Manufacture*, McGraw-Hill Book Co., New York City, 1931.

at short intervals, the costs of preparing for manufacture will be excessive. Obviously, there is a lot size, somewhere in between where the total unit cost will be a minimum for a given anticipated sales volume.

However, it turns out that this point of minimum cost does not constitute the point of greatest economy if employment of capital and return on investment are also considered. The fact is a larger return on each dollar invested in manufacture can be obtained over a considerable range of production quantities below that for minimum cost. Therefore, it is essential to know the lot size for maximum return together with the limits of the range. The minimum cost quantity will only be of value in determining which process of several is the best to adopt.

Timing is another important consideration in the coördination of manufacturing operations.<sup>2</sup> The machine load budget or master production schedule serves as the actual standard for operating performance. However, time standards for processing are necessary to make possible correct scheduling in conjunction with the quantity standards derived from lot size determinations.

Instead of scheduling successive operations independently, the principle of simulation can be employed to determine the most economical process time. Insofar as possible the final time standard should approximate the time for a single piece to pass through all operations plus that for the lot as a whole to pass through the longest operation.

In continuous manufacture there often arises the question of the economical number of machines to be assigned to the care of a single operator.<sup>3</sup> The optimum machine assignment will depend upon the probability that on the average a given machine which has automatically stopped from some cause will have to remain idle more than a specified time because of others which have chanced to stop just ahead of it and take precedence in demanding the attention of the operator. Obviously, if too many machines are assigned to one man the waiting or interference time becomes extreme, whereas, if each operator has too few, the apportionment of his wages to output will be high.

Again the economic balance between<sup>4</sup> technical factors of the process where the respective costs have diverse relationships to output is of marked significance in the selection of the best process. This type of problem may require one of several forms of approach. First, which of several optional methods offers the optimum operating conditions

<sup>2</sup> *Ibid.*, Chapter XV.

<sup>3</sup> The only literature on this subject are two unpublished manuscripts in the hands of the American Society of Mechanical Engineers.

<sup>4</sup> See E. L. Grant, *Principles of Engineering Economy*, Ronald Press Co., New York City, 1930.

for a specified average output? Second, what is the optimum combination of design features to be incorporated into the process equipment? Third, what is the optimum of optimums where both design features and operating conditions must be economically harmonized? The resulting standards for control will take the form either of design specifications, of instructions for the most efficient operating practice, or of the most economical capacity for each process unit where they are to be operated in multiples.

In the selection and replacement of *equipment*<sup>5</sup> measures of some sort are essential to demonstrate whether a machine has become obsolete through technological change, whether one or another type offers the greatest economy in performing a given operation or whether a machine can pay for itself in a reasonable time and thereby justify its purchase.

The approach in this instance rests in a year by year comparison of the total cumulative out-of-pocket costs for the proposed equipment against those for the present equipment should it be continued in service. The desired criterion of economic and technical superiority may be found in the time it will take for the savings from a change in equipment to cancel the additional investment with due regard for all legitimate credits and debits alike to the present and proposed equipment.

This criterion of the "breakeven point" takes no account of the requirement to earn a return on the investment. A more exacting criterion is the point of time where the rate of return on the investment in the proposed equipment will exceed that for the existing equipment. This is usually spoken of as the "true economic life."

Either of these criteria needs in turn a measure to demonstrate whether the equipment will have ample opportunity to satisfy the specified economic requirements. Physical decrepitude, inadequacy or obsolescence may cut short the serviceable life. Therefore, information upon these factors must be available as well.

In addition, the management should watch the trend of sales because if the volume of business declines, the accumulated revenues will be insufficient for the equipment to pay for itself in the appointed time. A knowledge of the secondhand market for equipment is also essential as it may be wiser to scrap a machine than to allow it to get into the hands of an irresponsible competitor at a relatively nominal investment on his part.

If the breakeven point is determined for each machine at the time

<sup>5</sup> See F. E. Raymond, "Fundamentals of Industrial Equipment Policies," *Mechanical Engineering*, July 1933, Vol. 55, No. 7, page 411. Also H. O. Vorlander and F. E. Raymond, "The Economic Life of Equipment," *A.S.M.E. Transactions*, 1932, Vol. 54, No. RP—54-2-29.



of purchase, control of plant equipment and its economic replacement can be rationally effected through budgeting of requirements. At the same time, the accounting for depreciation can be placed on a truly sound basis.

Since labor is one of the primary factors of production, what criteria exist to indicate the best that can be expected from the *men* employed? Incentive systems have been devised to encourage greater output through the offer of a reward. However, who knows what is a fair standard of output per worker or a fair reward without a conscientious study of the man and the job?

Through careful analysis of the flow of materials, of operation sequences, of the relation of the man to the machine, of work methods and work bench layout and of the actual hand and body motions, based upon the principles of "motion economy," true task standards can be established for which there will be a minimum of effort and fatigue.<sup>6</sup> This information will be basic to costing, rate setting, placement, and the scheduling of production.

In the choice of an incentive plan,<sup>7</sup> it is far from a simple matter to determine which system of the many already devised is best suited to the conditions in a given plant. The fact is, a high cost plan will obtain an average point of response for the workers at a much greater per cent of standard task, than for a less costly plan, with the result that the actual unit cost of output will be lower. Therefore, before installing an incentive plan, knowledge should be acquired of the nature of the work, the grade of labor, the need for a strong incentive and the general efficiency of production.

For the adequate control of *money* I need only point to budgeting technique as a review of the practices for compiling current budget standards would seem to be beyond the scope of this paper. It appears more to the point to inquire into what a knowledge of the economic structure of an enterprise under varying conditions of business has to offer as a basis for a truly flexible budgetary control system.

By means of a graphical device known as the Economic Crossover Chart<sup>8</sup> it is possible to depict the relationship and behavior of individual and total costs with total revenue over all probable sales volumes. The lower the crossover point in terms of sales, where revenue begins to exceed the total cost, the more flexible the cost structure. The chart serves primarily to throw into relief those costs other

<sup>6</sup> See A. H. Mogenson, *Common Sense Applied to Motion and Time Study*, McGraw-Hill Book Co., New York City, 1932 and E. Mayo, *Human Problems of an Industrial Civilization*, The Macmillan Company, New York City, 1933.

<sup>7</sup> See C. W. Lytle, *Wage Incentive Methods*, Ronald Press, New York City, 1929.

<sup>8</sup> See C. E. Knoepple, *Profit Engineering*, McGraw-Hill Book Co., New York City, 1933.

than fixed or directly variable which account for the inflexible features.

Degressive costs tend to rise rapidly for increasing output at relatively low levels of sales, though they become more nearly constant at higher levels. They present the chief obstacle to continued profits in periods of business recession. Progressive costs, on the other hand, are of minor consequence at lower levels of sales but rise more and more rapidly as the normal or economic volume of business is approached and exceeded. They are largely responsible for narrow margins of profit at times of excessive business activity.

The younger the enterprise or the industry the less effect have these progressive and degressive costs; the older or more mechanized the more serious they become. Similarly price changes for raw materials and manufactured products with corresponding changes in the level of wages tend to distort these relationships of cost differently in periods of rising or falling business activity. Unquestionably, a knowledge of how the cost structure of an enterprise is influenced by these factors is indispensable in determining policies of expansion or contraction in view of approaching prosperity or depression.

In regard to *materials*, the control of quality is of primary importance since in the last analysis quality must be "satisfactory, adequate, dependable and economic."<sup>9</sup> For the latest techniques of quality control, statistical criteria, quality standards and specifications and inspection methods, I need only refer to the outstanding work of Dr. Shewhart, Mr. Dodge and others of the Bell Telephone Laboratories and of Dr. Gaillard of the American Standards Association, with which I assume all statisticians are familiar.

Uppermost at this time is the question how can industry be assured that the quality of its products will be entirely satisfactory and acceptable upon delivery to the customer?<sup>10</sup> The point is, a quality has no significance unless the ultimate consumer has definitely expressed a desire to experience the satisfaction of the existence of that quality.

To obtain a final measure of satisfactory quality the enterprise must first ascertain just what are the wants of its customers,<sup>11</sup> and through its merchandizing division prepare product specifications which will serve as the basis for the final design specifications to be evolved by the engineering division. The process division, in turn, must issue operating instructions and production standards which the inspection division

<sup>9</sup> See W. A. Shewhart, *Economic Control of Quality of Manufactured Product*, D. Van Nostrand Co., New York City, 1931. Also John Gaillard, *Industrial Standardisation*, W. W. Wilson Co., New York City, 1934.

<sup>10</sup> See W. A. Shewhart, "Some Aspects of Quality Control," *Mechanical Engineering*, December 1934, Vol. 56, No. 12, page 725.

<sup>11</sup> See T. H. Brown, "Control of Distribution," *Mechanical Engineering*, December 1934, Vol. 56, No. 12, page 718.

will use as the basis for their measure of the run of quality and the rejection of defective units. Without knowledge of the incoming quality of raw material from the purchasing division there would be no guarantee of maintaining the approved standard of quality. Finally, through market research, proof of the initial interpretation of the desires of the customer will be obtained by measuring his acceptance of the product as manufactured.

Thus, it would appear that control should comprehend not only the measurement of conditions to be met and of the results achieved in dealing with them but also the evaluation of performance in terms of appropriate criteria of accomplishment. The statistician, comptroller and accountant each contribute the essential information derived from the former; the industrial or management engineer with his interest in fundamentals is in a position to supply the basic standards for the latter.

## THE KIND OF INFORMATION AN EXECUTIVE NEEDS TO OPERATE A FACTORY\*

BY WALTER F. TITUS, *Vice-President*  
*International Business Machines Corporation*

**B**EFORE discussing the kind of information an executive needs to operate a factory, it may be well to examine the aims of such an executive. Usually his title would be Works Manager. What does he expect to do? What is his job? While there may be exceptions, it can generally be assumed that the aim of the executive can be summed up in one word "Control." An expansion of this definition might be stated as, "The regulation and government of a manufacturing plant, its equipment, its personnel and its functioning, so that proper quantities of the proper products of proper quality will be produced at the proper time at the lowest possible cost consistent with continuation or expansion of the business."

Now, if the aim is "Control" then the factors that affect plant, equipment, personnel and operation must be taken into consideration. Here is where the difficult part of Control is involved—and that is the relation of one factor to all others. It is for this reason that the executive cannot afford to lose himself in a mass of detail. He must have a bird's-eye view of what is happening. To get too close to any particular function has a tendency to destroy perspective and to give undue values to undeserving factors. Perhaps the most valuable asset of management outside of vision of future is the ability to develop a perspective of the past and present and to recognize values at their proper stature.

A fairly common spectacle is to see an executive appointed to handle a factory, develop overhead-phobia. He becomes a maniac on elimination of overhead, and starts eliminating every possible item, the good along with the bad, and we find that costs, instead of descending, actually rise, and that plant equipment deteriorates and morale sags until at length the whole operation sinks into innocuous desuetude. These overhead-phobes consider only one angle—"if it isn't necessary to output, put it out," forgetting that while an item may not be necessary to output it may be very necessary to the business. In the early days of the cash register, the owner of a beer saloon could have argued

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that the purchase of a cash register was unnecessary overhead—and that beer and whiskey could be sold without the aid of a cash register. But they all bought cash registers because those devices safeguarded the income.

Other executives may insist on high cost tooling to secure low cost production when a proper perspective on output would indicate such action as entirely unwise.

If an executive is to maintain his perspective then, it becomes desirable that he avoid unnecessary entanglements and to this end he should limit the kind of statistics, reports and forecasts coming over his desk, to those which will be of value to him.

An appalling amount of statistics are collected and collated in some institutions. Then these are bound neatly into encyclopaedias and in many cases are just as useful as an encyclopaedia. All encyclopaedias are obsolete by the time they are printed and you cannot run business on last year's figures. Another trouble with collated statistics is that when some need exists for their use, we find all too often that proper relationships have not been established. We may find that our personnel statistics are without flaw and that our wage rate statistics are equally good—but what we are looking for at the present moment, perhaps, is some relationship between them.

In another instance, we may have the finest records of machine tool equipment with complete information as to possible ultimate output of each machine. But unless we have present capacity demand, how are we going to determine what to do when a new product is to be manufactured?

The first trouble in many instances with statistics, if we are going to use them as tools of management, is that they are usually obsolete. And the second trouble usually is that no matter how cleverly various factors have been related, there always arises a new demand for a different relationship than we ever thought would be necessary.

But while this is true of statistics prepared ahead of time when the statistician is unable to outguess the management, it is *not* true if basic units out of which statistics are built are kept in a liquid form with proper arrangements for keeping the basic units current and with proper facilities for developing any kind of relationships of factors at the time of demand.

Management does not need fewer statistics. What management needs is more and better statistics, and there would be a far greater appreciation of statistics by management if they once found out that statistics did not have to be obsolete and could be prepared in proper relationships at little cost and in a short time.

An executive must be an optimist in that he must assume that 95 per cent of what is going on is being done correctly. What he must take care of, then, is the correction of the 5 per cent which is being done incorrectly. He cannot go around complimenting persons on their ordinary accomplishments. He has not the time to do this, and this means too that as he cannot be in all places at all times, he cannot personally detect what should be corrected. The only way he can do this is by current operating reports and even with these, his organization should have corrected all troubles before he sees the reports, so that his job largely is one of checking up and supervision.

The kind and frequency of information really needed by a Works Manager will vary according to the size of the operation and the particular type of manufacturing being done. However, taking a 4,000 man metal working plant manufacturing a diverse line of machinery, it seems that the following reports are important.

The Works Manager will want a summary of the Daily Force report so that he knows at once the number of people working, the number hired, fired, laid off and out with illness. He will want a Daily Output report showing by main products, what has been completed, what has been shipped and what new orders are received or issued. A Daily Departmental Efficiency report is useful—not so much for action by the Works Manager—as for the fact that the foremen and supervisors know he gets it.

A daily Budget or Appropriation report keeps the Works Manager advised as to expenditures made or allowable so that he may approve or disapprove further expenditure for equipment or for inventory or operating or maintenance expense.

Inspection Reports and Field Performance Reports indicate to the Works Manager the quality of purchases, manufacture, design or assembly. Collected information indicating probable life of specific classes of parts used in the product is of great value to the executive in determination of policy as to kind of tools to be used in the manufacture of such parts. This is particularly true in an industry where the art is changing rapidly.

Inventory turn-over reports in general classifications indicate possibilities for better control of this important factor.

One of the most important reports for the Works Manager is the Wage Rate report. It is of vital interest to him that his working people receive rates consistent not only with comparable work elsewhere, but also that his wage rates within his own plant are consistent as to skill, fatigue, working conditions and importance of task.

Long swing Labor Turnover reports may show to the Works Man-

ager the desirability of a housing program or change in some phase of supervision or change in working conditions, or indicate necessity for better methods of training.

There are, of course, many other reports that may go over the Works Manager's desk but it seems that good organization and proper selection of junior executives should keep these to the junior executives' desks. Such reports as Payroll and Wage Changes and Accident and Traffic and Power and Unit Costs and Stock Position, Maintenance Expense, Welfare Expense, Commitments and Expense Budgets should receive the attention of such executives and be acted upon by them.

Naturally the Works Manager will be interested in the monthly operating statement because to some degree it will tell the story of his stewardship to his superiors, but the information contained in it should be anything but news. An operating statement is a cemetery of facts—an archive whose chief value may lie in guidance for the future. But the modern plant executive is not prone to be retrospective in his operations. He is dealing with the present. To him a cost statement, necessary and desirable as it is in other phases of business, merely points out mistakes of the past. It is negative in this respect, it is a constant reminder not to do this and not to do that. The live executive is more interested in what to do than in what not to do, and when it comes to Cost Reduction, reasons that it is foolish to analyse, for instance, a parts operation cost because nothing can be done about it unless the design is changed, the process is changed or the factory morale built up. This being the case, the immediate question is, if cost can be reduced by redesign of one product, why not others, and if process change can reduce cost in one piece, why not use the same process generally, and if better morale will reduce cost of one operation, why not reduce cost of all operations by building up morale in general?

A plant executive cannot control plant operations from behind his desk. Plant control is not a cold, calculating, lifeless thing—it involves too much of human relations and personal contact. In fact, if one were to ask a Works Manager for a quick answer as to what statistics he used as a guide in plant operation, he would mention far fewer than he actually uses.

But no business is successfully run without statistics, reports and forecasts. In themselves, they create nothing, they do nothing; but they inspire creation and they point to action and indicate decisions. Industry does not even yet consciously attach to figure facts the full significance and value that is theirs, but the appreciation is beginning to grow and will continue until management of industrial enterprise recognizes statistics as its right arm.

## WANTED—INDUSTRIAL STATISTICS\*

BY WILLARD L. THORP, *Director of Economic Research  
Dun and Bradstreet, Inc.*

STATISTICIANS are inclined to insist on the proposition that the business man engaged in actual economic operations should be vitally concerned with the statistics of his industry. We wonder how he can possibly survive without the aid and support of wall-charts and monthly mimeographed reports. We feel that without a steady diet from statistical tables, his mind must be in a continual state of bewilderment and frustration.

This morning, I propose to write the same prescription for our own profession, namely all those engaged as collectors, processors and distributors of statistics. We are an industry with problems of raw materials, technical processes and markets. And what is more proper than that statisticians should be concerned with statistics about statistics?

The twenties saw a boom in the statistical industry. And the last three years have seen the development and exploitation of many fresh deposits of new material in such varied areas as wholesale and retail trade, corporate earnings, real property and public health. It is fortunate that we have these causes for rejoicing, because the recent record of industrial statistics has reflected all too clearly the tendency of deflation, and the downward trend has not yet found a corner around which to turn.

I have prepared two simple tables of statistics about industrial statistics. I shall not defend their details. If twenty persons attacked the same problem, there might be forty different sets of figures. But I wish to make only one point, and I feel certain that each of the twenty tabulators would demonstrate this same point. In other words, the probable error, measured as a function of purpose, is so slight as to justify the statistical turpitude of hasty and rough procedure.

These tables are based upon the contents of the *Survey of Current Business*. They record the number of series, mostly monthly but a few quarterly, relating to specific commodities, excluding exports, imports, prices and data referring to non-processed agricultural commodities. In other words, they are the series of production, shipments, stocks,

\* Paper presented before the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 27, 1935.



orders, and sales of specific commodities. A list of all series included in the *Survey of Current Business Supplement*, published in 1932, was used as a basis for the first table. All series were listed according to the first year for which the data were available. They were also divided according to the nature of the compiling agency. The data are as follows:

Year	Private Agencies	Public Agencies	Total
1923	195	244	439
1924	227	255	482
1925	272	270	542
1926	297	279	576
1927	333	290	623
1928	353	319	672
1929	381	330	711
1930	390	374	764
1931	395	387	782

At least three comments must be made about the data themselves. In the first place, every eligible series included in the *Survey* is given equal importance, although they differ widely in both scope and significance. Second, the dates are those where the series actually begin, rather than when first compiled or published. Frequently, the compiling agency was able to push the data back several years before the date when compilation began, and also, many series were not included in the *Survey* until some months after compilation started. Consequently a table of the incidence of statistics-collection would probably show greater concentration in the later years than is presented. Third, no account is taken of quality. However, statistics were no exception to the general behavior of the period, when the emphasis was on quantity rather than quality. As a result, the gains on the qualitative side were much less significant.

Despite these comments, the record is one of which all statistics-promoters should be proud. The statistical series available from private sources were exactly twice as numerous in 1930 as in 1923. And public agencies did not fall far behind. To be sure, there were still various important industrial areas not yet occupied by the questionnaire and tabulating machine. Nevertheless, as far as industrial statistics are concerned, it certainly was a "New Era".

But the record since 1931 is much less cheerful. Each number of the *Survey of Current Business* has been examined for births and deaths of statistical series, with the following record of the surviving population at the end of each year:

Year	Private Agencies	Public Agencies	Total
1931	395	387	782
1932	377	365	742
1933	361	352	713
1934	353	342	695
1935	333	348	681

No change has taken place in the policy of the *Survey* which can explain this reversal in trend.

One must note that this record is not a complete picture of all industrial statistics. Unfortunately some series collected by private agencies are not made available to the Department of Commerce. Annual data and series subdividing published data in greater detail are frequently compiled. And some industries collect statistical material which cannot be reconstructed as a continuous monthly series for lack of comparable data. But the significance of the record given above cannot be suppressed by any amount of palaver. One cannot make light of the fact that, during the last four years, some 75 series of the type here discussed were included in the *Survey* for the first time, while 176 were discontinued. In addition, many series, while still existing, have been so modified or revised as to break the direct comparability with earlier years. The plain fact is that our industry is threatened at the source. To be sure, many of the discontinuances are series of little importance to one interested in the broad picture of general economic conditions. And we can encourage ourselves by noting a number of instances of improved quality. But, despite all such apologies, we are still thrown clearly on the defensive. The boom collapsed four years ago, and no recovery is in sight. We cannot afford to lose more ground.

One may attempt to explain away the turn of events as a mere depression phenomena—that, in their search for economies, business men found statistical work a mere adornment and a luxury which could be eliminated. Trade associations, meeting their budgets with difficulty, were forced to curtail, and there was no one concerned enough to defend the statistics except the meek little clerk who compiled them. This is no answer but merely a restatement of our problem. Why were the statistics of so little value that they could be discontinued without vigorous protests? Why were they regarded as luxuries, useful for wall-decoration or public speeches only?

Some would blame the decline on the National Recovery Administration, that alleged Pandora's box, by saying that the National Recovery Administration required so much detailed data that it destroyed

any goodwill previously developed towards such materials. But more than half the missing series has already disappeared by the end of 1933. In fact, the National Recovery Administration was our greatest hope for reversing the downward trend. Many code authorities had statistical series in the process of incubation, but the infant series were not strong enough to survive the cold blasts, when the Supreme Court opened all the windows. And despite the Schechter decision, the future of many series a decade old, is still decidedly uncertain. We cannot assume that the statistical industry has natural forces of recuperation that will assert themselves if we are only patiently inactive.

Certain statistics are collected and compiled entirely by government agencies. With curtailment of budgets for government bureaus a certain factor in the future, even these series may be threatened sooner or later. But neither did they advance quite so sharply in the boom, nor have they as tragic a record of collapse during the winters of discontent. I am particularly concerned at the moment with series compiled by government agencies in coöperation with private groups, or by private agencies themselves. Here are the greatest losses to date and the immediate danger in the next few months.

By and large, this type of statistical work must rest upon the proposition that the results are useful to the business men themselves. No effective appeal can be made on the basis that the Federal Reserve Board Index of Production requires their data, or that the *Survey of Current Business* has extra columns to be filled. Many of us desire industrial statistics in order to depict and analyze general conditions. We hunger and thirst after more and more statistics, that every corner of the economic picture be filled with correct detail. But we forget that we are but the indirect beneficiaries of products created for other purposes. Our use is a by-product use. With only a few exceptions, the business men who do the work and pay the bills want statistics pertinent to their own specific and immediate problems.

There is no reason why both demands cannot be accommodated. Unfortunately, we have too frequently lost sight of the business man's problems. We blithely and automatically urge collection of totals data on production, sales, shipments, stocks, and orders. Perhaps what he really needs is the record of stocks of raw materials on hand, sales through specific channels, or production by size and grade. A given industry may be divided into many semi-competitive groups, by product, area or nature of market, and the business man may be much more interested in his group, than in the industry totals. In research, we have recognized that problems define data. The same principle must carry over to our dealings with industries if we would convince them

that statistics are worthy of their time and money. Fit the statistical program to the questions disturbing the business man, and it will not be a luxury.

This same failure to consider the primary producer and consumer of statistics appears in our treatment of results. We have made little effort to demonstrate that the results of statistical work are significant. We send out a mimeographed sheet and assume that all exposed will be inspired by a mere column of figures. We ought to be able to put it in its broader setting and show its implications, but we don't. The business man is often afraid to discuss the results with others in the industry for fear of "restraining trade". Of course, eventually "truth will prevail," but we have not always given it much assistance.

Nor have we considered the business man in matters of speed of compilation, or economy of operation. We are interested in history, but he is making daily decisions. We must serve him much better than we have in the past, to earn his support. If we cannot develop statistical programs of definite value to him, but of general significance only, it is obvious that the task becomes solely a government function and we cannot urge private agencies to undertake statistics collection.

An additional weakness has been the failure to deliver complete statistical pictures. Two series relating to semi-competitive products greatly increase the value of each other, especially in these days of explicit competition between industries. More important is the necessity of supplementing manufacturing records with data on distribution. Stocks in manufacturers' hands are usually much less important than in the hands of distributors or retailers, yet how seldom can we supply the total picture. The development of integrated statistical programs may be the only way to earn support in some areas of economic activity.

Finally, we have over-sold the potential usefulness of statistics, and now stand convicted. Statistics have not saved the world, and must find their niche as did scientific management a decade ago. They have not stabilized industries nor assured profits. They have not eliminated uncertainty. Yet they can do much more than they have in the past. The boom days are over, and we must now build our structure on more solid foundations.

In the past, the chief agency promoting the compilation of statistics has been the government. The activities of the Department of Commerce were largely responsible for the rapid advance in the twenties. But the current reaction in business circles against government coöperation cannot help but seriously handicap that agency in its continued endeavors. I cannot help but feel that much of this responsibility must

be assumed by the professional statisticians of the country. It is a matter too close to us, to be lightly disregarded.

The serious nature of the present situation has been recognized by the Board of Directors of the American Statistical Association in the recent establishment of a Committee on Industrial Statistics. But the creation of a committee does not relieve the individual members of the Association of their responsibility. It merely defines a point of focus to which individuals can bring their suggestions and which in turn can develop a program for action. Surely, our collective intelligence and energy ought to be able to find ways of reducing the present high rate of industrial statistics mortality.

I hope that I have painted an extremely dismal picture, but it need not be discouraging. It merely means that we have been put to the test, and been found wanting at certain points. The reaction was bound to come, but we are still far ahead of the situation ten years ago. Perhaps by forcing us to re-appraise our relationship to the members of the business groups upon which we depend, it will result eventually in a more moderate but more permanent upward trend for the industrial statistics industry.

## A PROPOSAL FOR AN INTEGRATED PROGRAM FOR THE REPORTING OF BUSINESS STATISTICS TO GOVERNMENT AGENCIES\*

By S. M. DuBRUL  
*General Motors Corporation*

THE multiplicity of new governmental agencies set up in the past three years has led to much duplication of effort in the compilation of economic statistics. The increase in the number of questionnaires addressed to industry as a result of the Securities Act, the A.A.A., the N.R.A., the various research projects sponsored by the F.E.R.A., etc., has been enormous, so much so in fact that the cost of preparing the required material has placed a tremendous burden on industry.

The Central Statistical Board was charged with the responsibility of coördinating these various investigations and the elimination of duplication. The work of the Board in this regard is to be commended. Certainly had it not been for this organization, the burden would be far greater than it is at the present time. But even the members of the Board will admit that their efforts have not been entirely effective and that it will be a long time before a satisfactory degree of coördination results in eliminating the duplication which now exists and improving the quality and accuracy of the inquiries. Furthermore, there are many inquiring groups which are not subject to the jurisdiction of the Central Statistical Board so that its possible contribution to simplification remains limited. There are many State organizations not subject to the jurisdiction of that Board, in addition to a number of the Federal organizations, such as the Securities Commission, the Federal Trade Commission, etc., each of which may conduct its own inquiries without any required coördination with other Governmental agencies.

By the spring of 1935 this situation in the automobile industry had reached the stage of a major annoyance. Finally it was proposed that whenever inquiries other than those required by law were addressed to the members of the industry they should be forwarded to the Automobile Manufacturers Association for review. This procedure revealed a startling amount of duplication. It revealed further that many of the inquiries had obviously been prepared by persons whose knowledge of the industry was quite vague. Questions were couched in unfamiliar terms and it was frequently apparent that the information requested

\* A paper presented at the Ninety-seventh Annual Meeting of The American Statistical Association, New York City, December 27, 1935.

would not only be inaccurate but would be wholly misleading. The Association was then requested by the members to prepare a program for dealing with this situation which would relieve the members of the necessity of making so many individual replies and at the same time would assure the industry that when the information was furnished to the inquiring parties it would be accurate and not subject to serious misinterpretation. The Association was also requested wherever possible to make a consolidated reply for the industry in every case where it would be sufficient.

The staff of the Association accordingly went to work on this assignment which has resulted in the following procedure:

1. All inquiries, regardless of source, other than those required by law, are first sent to the Association for review.
2. The Association then determines whether a consolidated reply can be made for the industry as a whole from existing records (experience indicates that most inquiries can be handled in this way).
3. The Association then communicates with the inquiring organization to determine whether a consolidated reply will be satisfactory. If so, the members are then notified that the Association will take care of the matter.
4. This in no way interferes with the right of the individual member to make an individual reply if he so determines. For this purpose, the individual inquiries are returned to the members if they desire so that they may proceed with their individual replies.

This procedure has been in operation for some months and its results are eminently satisfactory to the members of the industry. Outside of certain schedules required by law to the various State and Federal organizations, practically no individual replies are necessary any longer except to the Association itself. The Association's program has been modified to comprehend all pertinent data so that the Association in turn can supply all proper inquiries. The expense of answering questionnaires has been materially reduced. The confusion attendant thereto has also been eliminated. The Association reports, being a routine matter, can be delegated to the clerical force. New inquiries only need be considered by the members to determine any policy questions which may be involved.

From the point of view of the inquiring bodies, this arrangement also seems to be eminently satisfactory. Most organizations only solicit the individual members in the industry to secure industry totals. When the Association explains that it can furnish the industry totals very readily, in a much more comprehensive fashion than can be obtained by direct questionnaire and with a detailed explanation of the reservations which

surround the information, that is, the deductions from it that are proper and those which are not proper, the inquiring organization is usually more than pleased to accept the Association's reply.

In a number of instances, the Association has been able to demonstrate that the information sought was not the information which the inquiring organization really needed for its purpose and that substitute information would be much more useful. In other cases, the Association has been able to demonstrate that the inquiries were entirely too brief for their purpose.

This procedure is entirely in accord with the general belief of industry that industrial statistics should to whatever degree practicable be compiled through the trade associations rather than directly by the Government.

Experienced and impartial persons in the field of industrial statistics all agree with this general position. The trade association is composed of and supported by the members of the industry and generally has far less difficulty in obtaining comprehensive data voluntarily than any Government agency. Furthermore, every industry interested in a statistical program at all will desire to collect much more detailed data than would be advisable for any Governmental agency to collect as a regular activity. Even though the Government were to collect the data in the detail desired by the industries, the burden of such an undertaking on a centralized basis is impossible to conceive, if the reports are to be economically and promptly summarized and distributed.

I am fully aware that there is strong opposition in some quarters to this position on the grounds that associations are poor custodians of confidential data; that they seldom appreciate the need for trained statisticians and that their tenure is often uncertain, and that consequently the Government should assume the task of gathering all reports of current economic activity. But in any industry in which the members are not sufficiently alive to their own needs for a good statistical program, the substitution of a Government agency, although it may produce more and better data in some cases, will not compel their use in better management of the industry and thus the data will be of only historical interest to a few students.

Furthermore, it is my belief that these admitted deficiencies of many associations can be remedied in time so that it will be entirely unnecessary for the Government to collect individual reports of current business transactions on a broad scale. My proposal for accomplishing this follows.

Before a trade association can be looked upon as a reliable agency for gathering economic statistics required for public purposes:

1. The continuity of its statistical program must be assured.



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Before a trade association can be looked upon as a reliable agency for gathering economic statistics required for public purposes:

1. The continuity of its statistical program must be assured.

2. The competence of its personnel must be demonstrated.
3. Its character as a custodian of confidential information must be demonstrated.
4. The adequacy of the coverage of its industry must be established.

Whenever an association qualifies under each of these four counts, there should be no hesitancy on the part of the Government to accept information compiled by it. Accordingly, it is proposed that the Central Statistical Board be empowered to certify to the other Government agencies those associations, the statistical work of which, after examination by the Board according to these standards, is sufficiently reliable that the Board can recommend the use for governmental purposes of the current data compiled by them. Thereafter, in any industry where there is such a certified association, no inquiries should be addressed to individual members by any Government department unless the information cannot be secured through the association. As a further strengthening of this stamp of approval, it would be desirable if the Board would also recommend that even non-members in the industry should make their reports in the first instance to the association, which will then transmit the schedules to the authorized agency empowered to seek it.

Of course, the Board should make it plain to all such associations that it reserves the right to require periodical proof that they are maintaining the Board's standards so that it could be assured of the continuing reliability of those whose activities it certifies.

It seems to me that this program would accomplish a number of worthwhile results. In the first place, it would draw a sharp line of distinction between those associations which are qualified to occupy a quasi-public position as a sort of branch of the Census Bureau as compared to those which are not so qualified. Once this mark of distinction became established, it would create a powerful pressure in the non-qualified associations to set up their activities in a manner which will enable them to become qualified. This would result not only in a pressure for better industrial statistics but would be bound to raise the whole plane of trade associations because in order to retain their marks of distinction for their statistical programs, the associations would naturally tend to raise their other activities to an equally high ethical level.

Furthermore, it would assure the compilation of statistics in the most economical manner. Decentralization of activity is always desirable to the greatest possible degree whenever efficiency is a consideration. The gathering of all industrial statistics in any broad way is an expensive undertaking and to decentralize the task among well-quali-

fied trade associations would assure a continuous check on the usefulness of the information, because the members, being conscious of the expense, would always be endeavoring to keep this activity on a justifiable basis.

A third advantage of such a program is that it would raise the plane of the personnel in the field. One of the requirements for certification would be the employment of competent personnel. The statistical profession would thus benefit since to obtain an approved status, the associations and their sponsors would have to recognize that economic statistics is as much a profession as public accounting, actuarial science, or architecture. Since the American Statistical Association is anxious to accomplish this recognition of its professional character, it should assist in the promotion of any program which will tend to accomplish that objective.

I am sure that a program of this nature properly worked out by the Central Statistical Board and presented to the various industrial groups would receive a hearty welcome by most of them and will greatly accelerate the production of better industrial statistics for all interested parties.

#### DISCUSSION\*

Discussion from the floor by Messrs. Hotelling, Thurston, Carpenter, Cohenour, Mitchell, Hunt, Belcher, Lutz, Meehan, Miss Joy, and others, centered around Mr. DuBrul's paper. It was pointed out that information for taxation and regulation of industry cannot be provided for the government through trade associations, who represent parties in interest; that not many trade associations are equipped to handle statistics and therefore only a small fraction of industry could be covered in this way. Some trade associations do not represent all of the important firms in their industries, and their history has been one of high mortality, the statistical series dying with them. On the other hand, it was stated that government agencies had occasionally discontinued data important to the industry through lack of funds, that government agencies often did not know enough about the operations of industry properly to phrase requests for data or to interpret the data when reported, and that government statistics also needed investigation from the industry's point of view. The importance of accurate interpretation was stressed. It was agreed that any program for improved industrial statistics would be slow to develop and would require close coöperation between government and industry, such as the Central Statistical Board had recently arranged for the textile industries in connection with the forthcoming Census of Manufactures. The importance to industry of integrated vertical statistics representing various stages of production and distribution, as well as production, employment and payrolls, as one stage of the process was stressed.

\* Summary of the discussion of Mr. DuBrul's paper, prepared by the chairman, Miss Aryness Joy

## EFFECT OF N.R.A. ON THE PHYSICAL VOLUME OF PRODUCTION\*

BY LEONARD KUVIN  
*National Industrial Conference Board*

**E**VIDENCES of the effects of the provisions of the National Industrial Recovery Act on the physical volume of production may be sought (1) in the magnitude of the movements of the total volume of output, (2) in the monthly pattern of the movements of the total, (3) in the characteristics of output of individual industries, and (4) in the economic influences of the process of coöperative action, or of specific measures in particular code agreements.

We can begin our inquiry with an examination of the movements of the composite index of manufacturing production of the Federal Reserve Board. We see in it an irregular but unmistakable advance from July, 1932, to July, 1933. During the ensuing months we observe a succession of movements which resulted in a net general decline. If our inquiry were based upon these observations alone and upon the fact that the National Industrial Recovery Act was signed on June 16, 1933, we might easily arrive at the conclusion that the decline in the total volume of manufacturing production in evidence after July was associated with the enactment of the law. We could state, further, that the increases in volume prior to July was a result of collective anticipation on the part of industry of increased costs of production. Some observers have seen in these facts the basis for a conclusion that the passage of the act resulted in the restriction and curtailment of production. By the same token, however, the lifting of the act should have resulted in an immediate expansion of output.

If we turn to movements of the index since May, 1935, when the act was pronounced unconstitutional, we witness a brief interlude of curtailment, even after cognizance is taken of seasonal retardation. Could it not be argued that the lifting of regulatory mechanisms failed of an assumed function? It could, however, be contended contrariwise that this was an interlude of a particular sort, in advance of the increases which we know followed in the second half of 1935.

Nothing but confusion of thought can result from such an analysis. Nor does it help matters to resort to a usual practice of statisticians, to

\* A paper presented to the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 28, 1935.

implement words and phrases with figures. We could go further, and examine industries in the aggregate at times when major codes were in force.

There is strong temptation at this point to construct an index of the physical volume of production that will include only such fields of activity as were regulated, introducing them at dates when codes were adopted. Such an index could then be compared with an index of production of all industries regardless of when codes became effective,—and deductions could be drawn.

This process is here waived for the fact that there are no better bases for circumventing the errors in reasoning about particular data of production than exist with respect to the composite of all of them.

Our basic difficulties arise from the fact that the volume of production of goods is affected by a number of economic factors not related to measures embodied in N.R.A. codes. Our economy is influenced in periods of depression as well as in periods of prosperity by world conditions, for one thing. Fluctuations in prices due to international arrangements affect domestic price levels. Changes in our general price level internally, brought about by monetary measures, are economic influences upon production of a high order of magnitude. Moreover, the availability of credit and the freedom of capital to flow into enterprise are items which have a direct bearing upon the physical volume of production. There are others which can be enumerated, but the purpose is here served by these few. To dissociate their effects from the influences of provisions in codes introduced at various times and in differing ways is virtually impossible. We pass then to our second consideration,—the pattern of monthly movements of the total.

The position taken in our first item of attack applies here with equal force. If N.R.A. exercised specific effects upon the pattern of monthly movements how can these effects be isolated from those of the other factors mentioned? The engagement of *post hoc propter hoc* reasoning, it may be unnecessary to state, has no place in a statistical investigation.

If we turn to an examination of the characteristics of output of particular industries, our third item, we find our way beset with the same difficulties.

In the cotton textile industry the prospect of increased labor and overhead costs prior to the adoption of the code was preceded by advances in raw materials prices induced by the suspension of gold payments. A sharp rise in output in the second half of 1933 was followed by a decline in 1934. To what extent was this latter movement a result of the textile strike in the third quarter of 1934, or to a reaction against

the accumulation of large inventories in the second half of 1933? Can this question be answered by a statistical study that will isolate the effects of the code? The position here taken is that it cannot.

We turn, therefore, to our fourth line of inquiry, namely the economic influences of coöperative action. For this the experience of the automobile industry will serve our purpose.

It can be claimed that the existence of a code induced the first concerted attempt to regularize output in the automobile industry. The revised code adopted in February, 1935, carried a provision for staging the annual show during November, instead of during January. While the possibility of changing the date had been discussed in the industry for years it is conceivable that the agreement to do so in the code provided the last necessary impulse to achievement.

Whether the modification of the pre-N.R.A. seasonal pattern will be a permanent matter is a question that will be answered by the manner with which consumers react toward the change. In any event, the shifting of the low ebb of production from November to September was accomplished in 1935.

The effects of this single change upon other fields of productive enterprise are easy to understand. Output of some divisions of the steel and iron industry were influenced and expanded by the shift in 1935. Auxiliary industries catering to the needs of the automobile, the steel, and the iron industries were similarly affected.

These influences may conceivably be accredited to N.R.A. But whether this change might not have arisen at the time had there been no code is worthy of serious thought, for it had become obvious in the course of the depression that increases and decreases in activity beyond seasonal expectation were recurring with regularity. Business men and students had become aware of the extra thrusts given to activity by the expected monthly forces of expansion and retardation. This knowledge alone might well have been responsible for the shift in the automobile industry.

With this we terminate our inquiry. The position taken in this discussion is that the statistical evaluation of effects is interwoven in the qualitative aspects of the problem, and cannot be dissociated from them.

We conclude by stating (1) that the effects of N.R.A. on the general physical volume of production cannot be dissociated from the effects of economic forces not related to N.R.A., and (2) that in particular industries those changes that may have been induced by the process of code adoption might otherwise have been induced by the observations of men in an altered set of general economic circumstances.

## UNEMPLOYMENT INSURANCE AND UNEMPLOYMENT\*

By M. C. RORTY

CERTAIN of the elementary facts with regard to unemployment insurance are very simple and quite familiar to most of us. We cannot make a something out of nothing. Business and industrial profits, on the average and in the long run, show negligible margins, if any, which can be diverted to increased wages or other payments to labor. Substantially the same conditions hold with respect to high salaries and bonuses. And, finally, there are no important margins of large incomes still untouched by efforts to "soak the rich," which can be drawn upon to cover the cost of unemployment insurance.

All these facts are adequately documented for those who wish to verify them. They lead to the necessary conclusion that the costs of unemployment insurance, to the extent that they are not offset by very doubtfully resulting direct economies and increases in productive efficiency, must be paid, in the end, either by the workers themselves, or, through increased tax burdens and prices, by consumers and those of very moderate means.

In this shifting of the costs of unemployment insurance to workers and consumers, the real question seems to involve not so much the ultimate results, as the successive steps by which the shifts will be brought about, and the time required. A combination of tax theory and experience, with the opinions of accountants and large employers, indicates that the immediate results will be some initial increases in the prices of goods and services, accompanied by occasional temporary reductions in profit margins. To this extent, those directly benefited by the insurance will profit for a time at the general expense of consumers and shareholders. In due course, however, the unemployment benefits should become substituted for increases in real wages which might otherwise take place, and the whole burden of such benefits will be shifted to the workers directly involved.

The preceding viewpoint is, of course, of controlling importance in a consideration of the whole problem of social insurance. The dangers of the situation do not lie in any conclusions which the average hard working citizen of modest means might reach, if he faced the facts squarely, and realized that the problem was simply one of a common

\* A paper presented at the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 30, 1935. [Colonel Rorty died on January 18, 1936. A tribute to his great service to the American Statistical Association will be published in a later issue of the JOURNAL.]



sense decision as to how much he, personally, was or was not willing to pay for specific insurance against economic hazards for himself and his family, as well as for more general protection for the superannuated, disabled, and incompetent.

If the average hard working citizen should reinforce such approach to the problem by avoiding generalizations and by considering just what could and should be done in his own community for particular individuals and families that he knows; if he would measure and balance each item of social insurance against its costs, and would then compromise and adjust to the levels of practical possibilities, and of maximum benefit per dollar of costs—under such circumstances we might have some real insurance that programs of social security would become worthy of their name, in place of threatening to become breeders of social insecurity and demoralization.

The unfortunate situation, today, is that the average worker has been promised the rainbow with a pot of gold at the end. He has not been asked honestly how much he would like to pay for social insurance, and of what kinds. On the contrary, the implied question has been how much he would like to have, if someone else did the paying.

Under these circumstances there is a special obligation upon the real well-wishers of the common man to protect him against the folly of his over-optimistic friends. Statisticians are not distinguished by great wealth. They show, perhaps, in more than average measure, the idealism and human sympathies of scientific workers as a class—but on the other hand they are specially trained to look facts in the eye. So it is the statistician, and particularly the economic statistician, upon whom may fall the principal burden of telling, from now on, the unpopular, but necessary, facts regarding current programs for social security.

My particular task on the present occasion is not, however, that of surveying the whole field of social security, and of balancing costs against possibilities of payment, and against the real value of social benefits. It is the more limited problems of determining how far unemployment insurance in general, and the typical present programs of unemployment insurance, may actually operate to reduce or increase unemployment.

This limited problem cannot, however, be wholly divorced from the broader problem of social security as a whole. In itself, an unemployment insurance program requiring total contributions at the rate of say, 3 per cent of payrolls would not be unsupportable, even when superimposed upon those other normal burdens of government and otherwise, which fall upon consumers and workers. It would represent, in the ordinary course of economic progress, no more than 3 years' gains

in real wages which had been diverted from current consumption by the employed, to similar consumption by the unemployed. At the end of such 3 year period we might not unreasonably expect to find that the average employed worker had as great a real income available for current living expenses as he had at the beginning of the period, plus the insurance benefits and protection as net gain during the interval.

On the other hand, if the unemployment program should prove to be the straw, or one of several straws, in the general social security plan, which finally operated to break the economic camel's back, any possible benefits from unemployment insurance would quite certainly be lost in the general debacle. Any separate consideration of unemployment insurance must, therefore, be subject to this general reservation, that it shall not prove to form part of a generally unworkable program.

We have already examined the reasons which indicate that the costs of unemployment insurance must be borne by the consumer and worker, and which justify the expectation that, in due course, substantially the entire costs will shift to the workers directly involved. This latter expectation carries with it an interesting corollary which bears directly upon the possibility that there may be a wide and wholly desirable latitude in the unemployment insurance plans of different states, without seriously hampering interstate competition between employers who are and are not subject to levies on their payrolls for unemployment funds. Even if the tax features of the present Federal legislation should be declared unconstitutional, there is a very real possibility that the shifting of the burden of insurance from prices to workers would take place at a rate sufficiently rapid to offset the annual increase of 1 per cent of payrolls in the levies on employers, which is contemplated in typical plans. In other words, it is entirely possible that wage rates will increase sufficiently more slowly in states which have insurance plans than in those which do not, to offset the payments made by employers. Eventually this should be the case, and employers will be wholly justified in insisting that wage comparisons between different areas shall not disregard difference in payments made by them into unemployment reserve funds.

But let us now consider the more specific angles of unemployment insurance.

The objectives of such insurance, according to various proponents, include:

1. The payment of lay-off benefits to temper the hardships which arise, even in normal times, through lay-offs and other changes in employment.
2. An extension of such payments which, without being carried to

the extent of providing complete relief in major depressions, will nevertheless serve as a large measure of relief in minor depressions and may, furthermore, operate to reduce their severity by maintaining consumer purchasing power.

3. A final extension of payments to cover complete relief requirements in times of long continued major depressions.

Of the preceding elements in any possible plan of unemployment insurance, the desirability of a reasonable scale of lay-off benefits, as such, has long been recognized by progressive employers. Such benefits, if carried only to the point justified for the tempering of the hardships due to shifts in employment during times of average business activity, will, however, involve expenditures of only a fraction of those contemplated by present programs, and would, even in theory, have little bearing on the major problems of employment stabilization and unemployment relief.

At the other extreme of possible programs, both our own recent experience and the longer experience in Great Britain have supplied convincing evidence that any plan of unemployment insurance supported by contributions from industry and workers, must be supplemented, in major crises, by much more general programs of public works and publicly supported relief.

To simplify our present discussion, we may eliminate both of the preceding extremes and ask ourselves a single question, which is—"Without attempting complete relief in major crises, how far, may a normal scale of lay-off benefits be expanded in the expectation that it will tend to reduce seasonal and cyclical unemployment?"

The question of seasonal unemployment, for our immediate purposes may be passed over rather quickly. Any system of unemployment insurance which allows even a very moderate incentive to the individual concern to reduce seasonal variations in employment cannot fail to have important value in eliminating many such variations which exist not of necessity, but mainly because of lack of systematic efforts to avoid them.

However, the maximum measure of such incentives may be only on the scale of 1 per cent of payrolls. Such incentives will not, and cannot, be directly effective in eliminating the more serious types of seasonal unemployment, such as those evidenced in the building trades and in bituminous coal mining. Buildings may be manufactured for stock in the future, but such possibilities are very limited today. Furthermore, bituminous coal can only to a very limited extent be stored at the mines. In these instances, and in others where the seasons or seasonal styles dominate, the elimination of seasonal variations in output must arise mainly through a stabilization of consumers' demands—and the in-

centive to the consumer for off-season purchases, or for risking losses through style changes, must be very substantial off-season price concessions. Furthermore, such price concessions cannot result from mere shadings in profit margins. These average only from 5 to 10 per cent of wholesale prices, whereas the price variations required to stabilize demand may range from 15 to 30 per cent. The indicated solution appears therefore to lie in substantial seasonal variations in the major cost factors, wage and freight rates being specially important. Such cost variations might even be carried back a second stage, as, for example, by encouraging winter building through lower winter prices on structural steel, plus lower freight rates, and wages for building labor—all these to be counterbalanced by corresponding increases in prices, wages and freight during the summer.

If we turn, now, to the major question of the possible influence of unemployment insurance in minimizing cyclical variations in employment, our first difficulty is in arriving at any definite proof of advantages or disadvantages. We may argue from British experience that unemployment insurance has contributed to both chronic and depression unemployment—or in the reverse direction, if we wish, we may contend that the recent relatively rapid British recovery has been due to the unemployment relief payments. But the only thing wholly certain is that such statistical correlations as exist run wholly true to form in proving exactly nothing at all. We are forced, therefore, as in most economic problems, to deal with general experience and tested cause and effect relations.

We know that arbitrary and rigid levels of prices and wages may lead to chronic unemployment and even to active business depression. We know, also, that when a depression has its source, in whole or in part, in abnormal price and wage levels—in prices and costs of production which are so high as to prevent the marketing of important volumes of goods in national or international trade—recovery will probably be delayed until such abnormalities are liquidated. But we do not know, unfortunately, just how far such liquidation may progress with advantage, and at what point it may, in turn, become itself the contributing cause to further depression, rather than to recovery. At the best, we can only surmise, from experience with depressions which have resolved themselves without running to extremes, that the desirable movement of prices and wages is one which only very slightly over-runs the point of adequate liquidation, and which permits of a substantially exact balance to be restored in the early stages of recovery.

Within these limits of what we know and don't know, it is possible only to arrive at a few definite conclusions.

Unemployment insurance which does not operate to prevent that

flexibility in wage rates which is required for the restoration of balanced price relations in times of depression, and which does not further those price and wage rigidities which breed chronic unemployment and acute depressions—such insurance should operate to maintain purchasing power, and in the case of moderate business reactions, not involving extensive liquidations or serious declines in capital goods activities, may operate in positive fashion to bring about recovery.

In the reverse case, unemployment insurance and, even more particularly, doles, which operate to further wage rigidities, will tend to create chronic or acute unemployment and to prolong periods of depression.

As a further general consideration, the need in times of depression is not for a maintenance of wage levels or even of consumer purchasing power, but for a prompt restoration of business and industrial profits and prospects. To put this situation in simple form—it is almost impossible to pay the shirt makers enough to put the carpenters to work, but when the carpenters are at work we do not need to worry about the shirt makers.

All these generalizations are far from that exactness and nicety of proof which is the pride of the statistician. They will constitute no proof whatever for those who are wholly unwilling to be convinced. But for those who are willing to follow the facts, wherever they lead, the evidence seems clear in economic theory, in experience, and in obvious cause and effect relations—and is not controverted by the available statistics—that unemployment insurance, at the best, can have little effect in stabilizing employment and at the worst may be a breeder of chronic or acute unemployment.

The real dangers lie, however, not so much in unemployment insurance, which in major depressions must soon be exhausted, but in supplemental doles and systems of relief which aim at, or tend to maintain, rigid levels of money wage rates at times when a liquidation and readjustment of price levels is required for business recovery.

All this might seem to be a hard and inhuman doctrine, were it not for the fact that experience shows a reduction in average *real* wages to be rarely, if ever, required. The maximum need appears to be for a flexibility in money wage rates which shall permit them to parallel declines in the cost of living.

Finally, it should be unnecessary to say that none of the preceding considerations are arguments against reasonable and properly administered systems of lay-off benefits—which are not perverted in the attempt to make them cures for, or preventives of, unemployment, or general systems of relief in major depressions.

## SETTING UP STATE ADMINISTRATION FOR UNEMPLOYMENT INSURANCE\*

BY GLENN A. BOWERS, *Executive Director*  
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SETTING Up State Administration for Unemployment Insurance" is particularly timely because of the pioneering stage of this phase of Social Security Legislation. In the administration of the New York Law, we are conscious of the fact that steps taken in this State may have an influence far beyond its borders. This peculiarly prominent position among all States is not of our choosing, but rather is due to the fact that New York is the largest industrial State and that the New York Law was the first to be established on the pooled fund principle and directly tied in with the Federal Social Security Act of 1935. It behooves us, therefore, to maintain as our constant goal the objectives of simplicity, economy and effectiveness of operation of this Law. We shall need a great deal of help, therefore, from Federal officials and those of other States and from other authorities.

For the benefit of those who do not recall its details, may I briefly summarize the New York Law. The contribution or tax is placed solely on the employer, this Law not involving employee contributions. The amount of the tax in 1936 is 1 per cent of the covered payroll; that is, all wages or remuneration paid to manual workers, and all wages and remunerations paid to non-manual workers receiving at the rate of not more than \$50 per week or \$2500 per year. In 1937 this tax becomes 2 per cent, and in 1938, 3 per cent of the covered payroll. Although the tax becomes payable beginning with employment on January 1, 1936, it is not to be paid, according to the requirement of the Law, prior to March 1, 1936. The Industrial Commissioner has recently extended this date, so that contributions are not to be paid prior to April 1, 1936.

All employers who have had four or more persons in employment covered by the Law within each of thirteen weeks in 1935 are required to pay contributions. Employment as a farm laborer is excluded, also employment of the employer's spouse or minor child and service performed in governmental agencies and in non-profit enterprises operated exclusively for religious, charitable, scientific, literary or educational purposes. Benefits to unemployed workers are not payable before

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January 1938. The maximum benefit will be \$15 a week, the minimum \$5; duration of benefits is equivalent to one week of benefits for each fifteen days of employment for a maximum of sixteen weeks. The actual amount of benefits is equivalent to 50 per cent of full time weekly earnings. No worker is eligible for benefits who has not had within the previous year 90 days of employment or within the previous two years 130 days of employment.

The New York Law is administered by the Industrial Commissioner. There is an Advisory Council of nine members, representing the employers, workers, and the public, appointed by the Governor. An Appeal Board will pass upon disputed benefit claims. Industrial Commissioner Elmer F. Andrews has created a Division of Unemployment Insurance and has combined with it the State Employment Service so that the two will operate as an integral unit. Beginning January 1, 1936, the executive offices of the Employment Service will be physically combined with those of the Unemployment Insurance Administration, and the work of the enlarged Division will be in operation on a functionalized basis. The Division will have four major functions, namely: (1) General administration under the executive director. (2) Placement service under the continued supervision of the director of the New York State Placement Service, Mr. William H. Lange. (3) Unemployment Insurance records control, under the supervision of the Comptroller of the Unemployment Insurance Division, Mr. Harry K. Herwitz. (4) Research activities, under the Director of Research, Dr. Meredith B. Givens. The remaining functions including interpretation of the Law, personnel administration and various duties under office management are classified under general administration.

The main office of the Division is located in Albany. There will also be a large office in New York City. The State will be divided into two administrative regions, the up-State region and the New York Metropolitan region, including New York boroughs, and Rockland and Westchester Counties, and all of Long Island. These regions will be divided into districts. The responsibilities of the regional and district offices will be supervisory in character. The local offices and the central offices will carry the bulk of the work. Employer and employee records will be centralized in Albany and in New York City. In the local offices the staff will have the dual functions of placement and unemployment insurance administration. They will be called local employment offices rather than unemployment insurance offices.

The combination of Employment Service and Unemployment Insurance in New York State is perhaps the most significant by-product of the new legislation. Without such coordination of services no State

in our judgment can effectively operate an Unemployment Insurance program. The incorporation of the employment service with unemployment insurance work should elevate the employment service to a position which it has long deserved but which it has not achieved in any State. Placement can no longer be looked upon as a voluntary, incidental public service. It need no longer continue in the position of "selling" its services to those employers who for various reasons have not wanted to use them. Properly administered Public Employment offices, in connection with unemployment insurance, should in time become a source to which employers and employees will turn naturally for their placement needs. The task of the employment service and of the unemployment insurance administration is to deliver high quality service, which is the best form of salesmanship for any enterprise.

The records and accounts procedure for New York State involves the following major operations: (1) registration of employers, (2) receipt and recording of employers' contributions, (3) record of employment status of individual employee, (4) record of benefit payments, and (5) general accounting.

Considerable discussion has occurred on the issue of maintenance by a state administration of individual employee data covering employment status and earnings. In New York, we have conferred for six months with employer committees, accountants, controllers, and others experienced in industrial payroll practices and in public administration. From these conferences, many suggestions for simplification have been obtained. This process is still going on. It is our belief that the system of record keeping eventually to be adopted for individual employee data must be sympathetically understood and concurred in by those who are to submit reports as well as by the State administration. This follows the principle that no Law is effective unless it receives the support of the majority of those who are required to comply with it.

Having in mind the many phases of this accounting problem, which have not yet been adequately explored, including the necessary coordination of State records administration with the requirements of the Federal Social Security Board, the Collector of Internal Revenue and the United States Employment Service (with respect to placement data), the question of amending the New York Law so as to permit more time for working out solutions to these problems was raised with the New York Unemployment Insurance Advisory Council. This Council has recommended and the Industrial Commissioner has concurred in this recommendation to the Governor and to the Legislature that the New York Law be amended to make unnecessary the assem-



bling of individual employees' work records during 1936. This will be accomplished by amending Section 503, Subdivision 3, Paragraph C of the Law, so that employment during 1936 would not be used in qualifying employees for unemployment-benefits to be paid after January 1, 1938, when payment of the benefits will begin. If the Governor and the Legislature concur in this recommendation, the additional year available for preparatory work should ease the pressure in setting up the necessarily large administrative organization and make possible our gradual assumption of responsibilities. Employers, likewise, will have an opportunity to adjust their own payroll records simultaneously to meet the requirements of the Old-Age Benefit section of the Federal Law and of the State Law for Unemployment Insurance.

The general accounting procedures under the New York Law involve the setting up of an Unemployment Insurance Fund, an Unemployment Trust Fund, and an Unemployment Administration Fund. Into the Unemployment Insurance Fund will be placed all contributions collected by the State of New York which are reserved exclusively for the payment of benefits. This fund is in fact little more than a record of contributions received. These funds are placed at once in the Unemployment Trust Fund with the Secretary of the Treasury of the United States for the account of the State of New York Unemployment Insurance Fund. The moneys are invested by the Secretary of the Treasury. The earnings of the moneys in the Unemployment Trust Fund are credited to the account of the State of New York Unemployment Insurance Fund at proper intervals or when they are withdrawn. When moneys are required for the payment of benefits, a requisition is made on the Secretary of the Treasury, who then returns the required funds to the Commissioner of Taxation and Finance of the State of New York to hold until disbursed as directed by the Industrial Commissioner. The Unemployment Administration Fund consists of moneys received for the administration of the New York State Law. It is administered by the Commissioner of Taxation and Finance and the State Comptroller as in the case of other State moneys.

Obviously, there are many problems connected with the setting up of the administrative organization in a State such as New York which have not been specifically mentioned in this paper because of the necessity for brevity. We feel that within the limits of the \$100,000 advance made by the 1935 Legislature for the initiation of this program, we have a reasonable degree of control over our situation. Two instructions have been issued to employers, the first one specifying that following information shall be maintained on employer's records:

- (a) Insured employee's name
- (b) Wages earned during payroll period
- (c) Number of days worked during payroll period
- (d) Total number of hours worked during payroll period
- (e) Full scheduled hours per week for employees or group of employees
- (f) Date when employee quits or is "laid-off," either permanently or temporarily, or is discharged
- (g) Date employee is hired, or reinstated after "lay-off," or is rehired
- (h) Place of employment (city or town)

The second instruction states that an employer covered by the New York Law should submit an initial statement with certain general information about the employing organization. This statement is for the purpose of employer registration and does not require the reporting of individual employee data. As already stated, individual employee data will not be required prior to April 1, 1936, and if the Legislature concurs in the aforementioned recommendation, they will not be required before January 1, 1937. Meanwhile, detailed instructions can be prepared covering such employee reports.

The problems of Unemployment Insurance in New York are not confined to issues arising solely within the borders of this State, they involve also relationships with other States and particularly with the Federal Social Security Board and other Federal agencies. The situation with which all States are faced as regards consistency of rulings in the various States and interpretations consistent with the views of the Federal authorities is indeed a serious one.

The issue of centralization versus decentralization of control over unemployment insurance is only beginning to be recognized. It is the old issue of States' rights standing out against concentration of control in Washington. But the form of the question today is the achievement of national standards through agreement by the States as opposed to Congressional determination. An answer to this question as it pertains to unemployment insurance may be expressed during the coming year by the Supreme Court of the United States. The final answer, however, rests during the years to come with the practicalities of the complicated relationships of government with the economic life of its citizens.

Chief among these practicalities are (1) the structural organization of business and industry and (2) the migratory habits of our population. If, for example, there is to be a continuance or further increase in nationwide business enterprise through interstate corporations or comparable agencies, then the application of reasonable and effective national standards and uniform procedures is inevitable. On the other hand, return of American life to a condition of local self-sufficiency

would avoid the problems of interstate economics, commonly called interstate commerce, and would make practical once more a truly local self-government, along State lines. The trend and the logic are clearly in the direction of further development of consistent national standards for unemployment insurance and its administration.

This problem is not one of mere political theory for a soap box oration; it is one of immediate significance to the Unemployment Insurance Administration in New York and in other States. Are we in New York to work out our own treaties of reciprocity with adjoining States and with other States in which New York residents perform their work? Will we be obliged to incorporate the "most favored nation clause" in treaties between the "Sovereign State of New York" and the "Sovereign State of New Jersey" so as to avoid double taxation on the employer of interstate employees? Is an employee to lose his unemployment benefit rights if he moves from one side of the street to the other, thus crossing a State line and changing his State residence? Will there be consistency in interpretative rulings among the States on identical issues?

These are but a few of the questions confronting State administrators. We naturally look to the Federal Social Security Board for guidance and have confidence that the close coöperation of State officials with that Board will produce sane and equitable answers to them.

Finally, may it be said that the success of State administration of Unemployment Insurance appears to rest upon broader grounds than the immediate requirements of any State Law. It involves coördination with Federal procedures for Old-Age benefits so as to make possible simplified employer reports and to avoid duplication of employer reports to Federal and State agencies. It will involve a high degree of coöperation on the part of all States with one another under the positive and constructive leadership of the Federal Social Security Board. With this Board, I dare say, all State administrations will be inclined to coöperate to the fullest of their ability, once the way is open to them for the development of effective standards and uniform procedures throughout the United States.

## REAL WAGES OF ARTISANS IN LONDON, 1729-1935\*

BY RUFUS S. TUCKER

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**P**ROBABLY no subject in the field of economic history is as important in its implications for present policy as the purchasing power of the working classes. It has been studied by many economists, who have accumulated a mass of statistical and non-statistical information, but very few attempts have been made to present the results in the form of an index number, except for the years since 1913. Index numbers, no matter how well constructed, do not furnish a complete picture of any economic problem, but they are desirable as a plane of reference, as a check on scattered quantitative expressions, and as a guide to points or epochs requiring further study. Non-quantitative opinions, even when buttressed by quotations from contemporaries, are inexact and frequently unreliable. People at any time compare conditions with earlier times within their own recollections, and human nature is such that for those who are out of office or out of luck the best that they can remember is the norm, and the present is always a time of depression or retrogression. For those in office or in funds, on the other hand, the present is usually a time of unprecedented progress and prosperity. Each side can present scattered bits of evidence to support its position, and base a social philosophy on the fate of hand-loom weavers or the price of wheat. Doubtless most economists would agree that an accurate knowledge of the purchasing power of the working classes during the industrial revolution is important enough to warrant the preparation of more quantitative checks, guides, and summaries than have yet appeared. Since England was the home of the industrial revolution, and English statistical material more complete in the earlier years, this index has been prepared, referring to wages and prices in London.

As Dr. Gilboy has pointed out, conditions in different parts of England were so diverse that a sound study of wages and prices must be restricted to one locality. It is perhaps not sufficiently realized that a study of the cost of living must also be restricted to commodities entering directly into the cost of living. Even in ordinary times raw materials and consumers' goods have very different movements. In an epoch when methods of production were being drastically changed the divergence between movements of raw material prices and those of

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finished goods must have been even greater. All the index numbers available for England before 1850 are based on raw materials and foods; most are weighted without reference to the relative importance of their components in the consumers' budget; most include imports without allowing for import duties that were added to the price the consumer had to pay. They cannot therefore be relied on as measures of the cost of living or the purchasing power of money, and the attempt to use them for that purpose has led to some very debatable conclusions. Mr. Keynes has pointed out the theoretical reasons for suspecting that indexes of wholesale commodity prices cannot portray accurately the purchasing power of money. The index that I am about to describe confirms his suspicions, for it differs widely from the existing wholesale indexes.

In constructing an index number of commodity prices over a long period one is faced with two problems—one statistical, one economic—which require the same answer. The statistical fact is that there are practically no continuous series of price quotations referring to the same commodity, or the same quality of a commodity, that cover the whole period under review. The economic fact is that many commodities once important became unimportant, and that many once unknown came to occupy an important place in the typical consumer's budget. For example: the substitution of kerosene for candles and its subsequent replacement by gas and later by electricity; or among foods the declining importance of beer and cheese and the increasing importance of tea, cocoa, sugar, and fruits. Foods of all sorts took up a smaller part of the total consumption of workingmen as their condition improved, and manufactured articles and services became more important. The answer to both these problems is found in the construction of a series of indexes, each covering a period of moderate length in which prices are comparable and consumers' habits nearly unchanged, and welding them on to one another to form a continuous chain.

The links in this chain are as follows: 1729–1800; 1790–1818; 1815–1821; 1819–1832; 1828–1835; 1833–1837; 1836–1850; 1847–1862; 1862–1868; 1868–1873; 1870–1880; 1877–1900; and since 1900 the Ministry of Labour indexes of the cost of living. In most cases the links overlapped two, three or four years. In 1862 overlapping was not necessary as the items dropped were unimportant and were replaced by similar ones. In 1868 the nature of the available material for adjoining years made overlapping inadvisable. A supplementary index including all the items continuously available was worked out for 1847, 1850, 1857 and 1873, and it was found to correspond very closely with the chain index. By using this device ordinary interpolation was almost entirely

avoided after 1805. Before 1805 the complete index could only be constructed at five-year intervals, and figures for the intervening years are interpolations based on a smaller number of items.

Each link was a weighted logarithmic average of consumers' goods, i.e., goods that required no further processing than what was customarily performed in the consumers' households. Thus we have bread and flour, but no wheat (except for interpolation before 1735); clothing, cloth, worsted and sewing thread, but no wool, cotton or flax; shoes, but no leather. The weights for the eighteenth century were based on budgets published by Dr. Gilboy. For the first half of the nineteenth century they were based on studies by Wood, Chadwick, Neild, and Lowe, and on the official ration of the Chelsea veterans' hospital. After 1870 the chief authority has been the Ministry of Labour, but the practise of American and Swedish authorities has also been considered, and the relative weight of food is slightly less than in the Ministry of Labour's index, in order to make room for sundry manufactured articles.

The weights of foods aggregated 75 per cent of the total index until 1815, 67 per cent until 1850, and 60 per cent thereafter. Clothing accounted for 14 per cent until 1815, 18 per cent from 1815 to 1850, and 20 per cent after 1850. Fuel and light accounted for 7 per cent before 1815, and 9 per cent after that year. The rest of the items, sundry manufactured articles, varied from 4 per cent to 11 per cent.

Although a complete list of articles quoted, the number of quotations for each, and their weights, cannot be given here in the space allowed, the list for 1729 will give an idea of the representative nature of the index in its least representative period—for in later periods the number and variety of items was much greater. In 1729 there were 18 quotations for food, 7 for clothing, 4 for fuel and light and 2 for sundries. There were 19 individual commodities:—butcher's meat, bread, butter, cheese, peas, oatmeal, beer, malt, hops, salt, coats, shoes, stockings, hats, uniforms, coal, candles, mops, and blankets. Tea, sugar, and tobacco were soon added, then spirits and illuminating oil, and the number of sources for each commodity increased, especially after 1780. The number and variety of items increased so that from 1815 to 1835 there were usually over 100 quotations referring to over 50 distinct commodities, and directly covering probably over 90 per cent of the expenditure of a working-class family other than rent and medical attention. After 1835 the clothing items are less complete but foods are even better represented than before. The index after 1880 is merely a recalculation of the Ministry of Labour index with some manufactured sundries added; and after 1900 the Ministry of Labour indexes

are used with no change except reduction to a common base.

All the prices used are taken either from official reports or from the data used by other compilers of index numbers, such as Silberling, Newmarch, Sauerbeck, Jevons, and the Board of Trade. The chief source from 1729 to 1868 was the record of prices paid for supplies by Greenwich Hospital; from 1729 to 1832 the corresponding prices for Chelsea Hospital were also used; and from 1815 to 1853 similar prices for Bethlem Hospital. After 1853 most of the prices are taken from the Economist or Sauerbeck indexes, or from the Board of Trade's 1903 Report on Wholesale and Retail prices. From 1847 to 1880 sundry manufactures consisted largely of Soetbeer's average of 14 manufactured British exports, which he used in compiling his index of the cost of living in Hamburg. From 1880 to 1900 Silverman's index<sup>1</sup> of British export prices was used to supplement the Ministry of Labour index, since it consists mainly of coal, textiles and sundry manufactures eligible for inclusion in a list of consumers' goods.

In this manner an index of prices of consumers' goods was attained. It is not a complete index of the cost of living, for it omits services, including the services of retailers, and it omits rents. Rents are certainly important, but there is no way to ascertain directly what they amounted to from year to year. The scattered information compiled by Bowley and Wood and earlier writers seems to support the hypothesis that rents of artisans in London strongly tended to equal one-sixth of their weekly wage. It is reasonable to suppose that rents of workingmen's houses should fluctuate with wages, for wages constitute the chief element in demand, and also an important element in supply. Available figures for prices of building materials do not correlate well with the rents reported; neither do the statistics of interest rates or population density. Consequently in order to cover rents and services not included in the prices of commodities a hypothetical cost-of-living index has been calculated, consisting of the consumers' goods index with a weight of four and wages with a weight of one. A similar average of commodities and wages was used by Arthur Young for the same purpose over a century ago. This hypothetical cost-of-living index is the basis of discussion in the remainder of this paper. If any one prefers he can use the consumers' goods index, and if he does so he will get more extreme fluctuations in real wages and a sharper upward trend from 1800 to 1900.

An index of real wages is of course constructed by dividing an index of money wages by an index of the cost of living. The index of money wages here used is based on compilations by Wood, Bowley, Hirst,

<sup>1</sup> A. G. Silverman, *Review of Economic Statistics*, August 1930. (Vol. XII, p. 139 ff.)

and the Ministry of Labour, and Hardy's figures for artisans employed on public buildings. There are many trades included after 1780, although before 1850 most wage series are available only for selected years, except some series for artisans in the building trades. Here we have four kinds of labor at Greenwich for every year from 1729 to 1868 and at Chelsea from 1807 to 1818. Before 1780 the only available wages were in the building trades, and those used were largely taken from Dr. Gilboy's book, or kindly supplied by her for this index. It is very likely that other wages were not so inflexible, and possibly they had more of a rising trend from 1750 to 1800; it is highly probable that wages of unskilled laborers rose more than wages of artisans, but conclusive evidence is lacking.

So here we have the index of real wages. Before describing its movements and drawing conclusions from it a warning is in order. An index of real wages is not a complete index of the income of the laboring class, still less of its welfare. For one thing, unemployment must be allowed for. However, Wood's study of this point, for the years between 1850 and 1900, shows that allowance for unemployment does not affect the picture very much, and especially does not alter the trend. Bagge's study of real wages in Sweden since 1860 leads to the same conclusion. Of course there are no reliable statistics of unemployment in earlier years. In view of a widespread impression it is worth while mentioning also that unemployment is not invariably greater in years of low prices, although there is a tendency for it to increase for a while when prices decline suddenly.

Another point to bear in mind is that working hours have been reduced from 72 or even 84 a week to 48 or less. Since these indexes are based on weekly wages they greatly underestimate the increase in the purchasing power of an hour's labor. A third point is that in the last hundred years the services rendered by the state have increased greatly in variety and importance. These fall mainly in the field of sanitation, education, and amusement, and cannot be shown by price indexes. Finally the size and comfort of workingmen's dwellings have increased, partly on account of housing laws. On the whole the condition of the laboring class, if it could be represented by a curve, would rise more rapidly from 1832 to the present, with smaller fluctuations.

The index of real wages then measures the ability of a typical, regularly employed London artisan to purchase commodities of the sort artisans customarily purchased. It attempts to measure also his ability to purchase housing. It covers probably more than nine-tenths of his expenditures, which is as large a proportion as any published index number for recent years. But it is only one measure of the welfare of



INDEXES OF PRICES OF CONSUMERS' GOODS, MONEY WAGES, COST OF LIVING,  
AND REAL WAGES IN LONDON, 1729-1900 (1900=100)

Year	Food	Clothing	Fuel and Light	Sundries	Total	Money Wages	Cost of Living	Real Wages
1729	64.8	171.2	89.4	148.3	78.5	42.7	71.4	59.8
30	57.9	168.4	85.1	125.7	72.2	42.2	66.2	63.8
31					62.3	43.1	58.4	72.1
32					60.4	43.1	56.9	75.7
33					65.6	43.1	61.1	70.5
34					69.9	43.1	64.6	66.7
35	54.4	158.0	72.1	127.2	67.6	44.0	62.9	70.0
36					69.2	44.0	64.1	68.6
37					71.7	44.0	66.2	66.5
38					73.2	44.0	67.3	65.4
39					84.7	44.0	76.6	57.4
1740	83.8	157.7	90.1	137.3	95.1	44.0	84.9	51.8
41					77.8	44.0	71.0	60.2
42					76.4	42.4	69.6	60.9
43					71.6	42.7	61.0	70.0
44					71.9	43.6	66.2	65.9
45	68.0	156.0	91.2	140.6	81.3	39.8	73.0	54.6
46					88.2	43.6	78.1	55.8
47					86.7	44.0	77.9	56.5
48					88.8	44.0	79.7	55.2
49					91.3	44.0	81.6	53.9
1750	81.4	155.6	87.9	139.8	92.8	44.0	83.0	53.0
51					102.7	44.0	88.0	50.0
52					97.7	44.0	84.2	52.3
53					100.1	44.0	86.0	51.2
54					83.4	44.0	76.9	57.2
55	74.5	159.0	92.4	137.7	87.3	44.0	78.6	56.0
56					127.0	44.0	100.0	44.0
57					118.4	44.0	95.7	46.0
58					98.1	44.0	85.1	51.7
59					89.8	44.0	80.9	54.4
1760	79.0	158.0	98.1	140.9	91.6	44.0	82.0	53.7
61					86.6	44.0	78.1	56.3
62					90.8	44.0	81.4	54.1
63					88.2	42.2	79.0	53.4
64					91.1	44.0	81.7	53.8
65	82.8	160.3	94.5	141.4	95.4	44.0	85.1	51.7
66					97.1	44.0	86.5	50.9
67					100.8	44.0	89.4	49.2
68					99.7	44.0	88.6	49.1
69					91.8	44.0	82.2	53.5
1770	85.0	135.7	94.3	148.1	94.5	44.0	84.4	52.1
71					101.8	44.0	90.2	48.8
72					109.7	44.0	96.6	45.5
73					109.9	44.0	96.7	45.5
74					107.5	44.0	94.8	46.4
75	95.6	129.4	88.3	158.8	102.6	44.0	90.8	48.5
76					93.9	44.0	84.0	52.4
77					103.9	44.0	91.9	47.9
78					99.4	44.0	88.3	49.8
79					94.0	44.0	84.0	52.4
1780	88.1	131.3	107.5	164.2	98.1	44.0	79.3	55.5
81					106.6	44.0	94.1	46.7
82					111.4	44.0	98.0	44.9
83					110.4	44.0	97.1	45.3
84					107.5	44.0	94.8	46.4
85	96.4	130.4	107.5	164.2	105.0	44.0	92.9	47.4
86					101.8	44.0	90.2	48.8
87					102.4	44.0	90.7	48.5
88					102.0	44.0	90.4	48.7
89					105.1	44.0	92.9	47.4
1790	101.6	137.5	111.0	160.7	111.1	45.1	97.9	46.1
91					107.7	45.1	95.2	47.4
92					106.1	45.1	93.9	48.0
93					113.3	45.9	99.8	46.0
94					115.2	46.7	101.5	46.1

Year	Food	Clothing	Fuel and Light	Sundries	Total	Money Wages	Cost of Living	Real Wages
95	127.5	136.4	147.7	194.1	134.6	48.6	116.7	41.4
96					133.6	49.4	116.8	42.3
97					130.8	51.0	115.4	44.2
98					132.5	51.1	116.3	43.9
99					144.0	51.1	125.5	40.9
1800	189.9	152.6	162.5	236.8	183.1	51.1	156.7	32.6
01					186.2	52.6	159.5	33.0
02					185.9	53.1	135.4	39.2
03					161.6	53.3	139.9	38.1
04					163.0	53.7	141.2	38.0
05	181.8	172.0	166.5	227.2	180.6	54.8	155.5	35.2
06	176.4	169.0	160.2	213.8	175.6	54.8	151.4	36.2
07	147.4	150.6	160.5	213.2	173.5	60.8	151.0	40.3
08	186.1	153.4	187.4	229.3	182.8	63.0	158.9	39.6
09	207.6	166.6	199.8	237.3	201.9	64.2	174.2	36.9
1810	207.6	166.8	192.6	236.7	201.9	66.5	174.4	38.2
11	205.1	164.4	189.8	233.6	198.9	69.5	173.0	40.2
12	231.7	168.6	191.2	229.3	219.1	69.5	189.2	36.7
13	234.7	165.5	201.1	244.1	225.4	70.0	194.4	36.0
14	198.4	184.8	207.2	356.9	201.8	70.6	175.5	40.2
15	174.0	188.8	178.4	315.1	180.6	70.6	158.6	44.5
16	171.3	185.6	148.4	303.2	176.2	67.3	154.4	43.6
17	188.6	183.2	158.6	266.4	181.4	66.4	158.4	41.9
18	184.8	166.0	162.3	293.7	183.3	66.4	160.0	41.5
19	178.3	176.5	155.9	259.2	180.2	65.1	157.2	41.4
1820	166.1	172.4	138.2	237.1	168.7	64.7	148.0	43.7
21	144.8	181.9	128.1	238.2	153.7	65.4	136.0	45.7
22	125.3	166.2	123.0	250.7	136.4	65.4	122.2	53.5
23	132.1	155.0	119.4	241.5	139.0	65.4	124.2	52.7
24	139.9	150.2	109.4	209.2	141.2	66.1	126.2	52.4
25	156.7	150.9	125.5	191.9	154.5	66.9	137.0	48.8
26	150.2	148.1	121.4	188.5	148.1	66.1	131.7	60.2
27	143.9	155.4	121.5	184.0	145.0	66.2	129.3	51.2
28	139.2	148.9	115.8	183.0	140.1	65.9	125.2	52.6
29	139.2	138.6	110.6	177.1	137.4	64.3	122.8	52.4
1830	128.1	137.5	106.3	167.4	128.9	65.3	116.2	56.2
31	137.9	147.8	99.5	156.1	137.9	63.3	122.9	51.5
32	133.6	156.2	99.6	162.1	135.5	63.2	121.0	52.2
33	129.3	137.7	83.0	166.3	128.1	63.4	115.2	55.0
34	118.8	145.3	82.0	177.7	122.6	63.5	110.8	57.3
35	113.2	150.2	84.9	181.2	120.6	62.3	108.9	57.2
36	124.3	149.1	87.6	182.1	127.8	61.3	114.5	53.5
37	135.2	147.5	100.4	172.5	136.5	61.2	121.4	50.4
38	135.5	144.8	100.1	162.4	135.7	61.2	121.6	50.3
39	153.7	145.4	104.7	162.5	148.3	61.2	130.9	46.7
1840	144.0	141.3	97.8	161.0	140.3	61.2	124.5	49.2
41	152.2	141.6	97.7	161.5	145.7	61.6	128.6	47.9
42	138.8	136.2	95.5	152.4	125.3	61.6	112.6	54.7
43	124.3	130.4	92.3	149.0	124.1	61.7	111.6	55.3
44	123.8	132.6	87.3	145.1	123.3	61.9	111.0	55.8
45	131.2	133.0	89.0	144.3	128.4	61.2	115.0	53.2
46	151.7	142.6	81.5	153.0	142.7	61.6	126.5	48.7
47	159.4	140.8	92.5	150.6	149.5	61.6	131.9	46.7
48	139.2	134.9	88.8	139.4	132.6	61.6	118.4	52.0
49	128.9	131.6	84.0	139.2	125.4	62.1	112.7	55.1
1850	118.5	135.0	78.5	141.1	119.2	62.6	107.9	58.0
51	115.8	140.5	73.3	130.5	117.0	63.0	106.2	59.3
52	115.9	125.6	73.6	131.1	114.5	64.0	104.4	61.3
53	136.1	131.3	83.4	135.1	129.2	66.0	116.5	56.7
54	148.4	129.4	103.2	130.1	137.8	66.6	123.5	53.9
55	151.7	128.3	97.7	127.8	138.4	67.3	124.2	54.2
56	153.6	128.7	96.0	128.4	140.6	67.4	126.0	53.5
57	150.9	132.9	93.2	132.2	138.8	67.3	124.5	54.1
58	127.9	135.9	96.5	130.6	126.5	67.3	114.6	58.7
59	138.8	139.1	90.0	135.6	131.4	68.0	118.7	57.3
1860	140.5	146.8	91.4	131.7	135.7	68.3	122.2	55.9
61	147.5	138.5	94.5	134.3	138.5	69.1	124.6	55.5
62	143.8	148.0	90.0	143.8	140.2	70.2	126.2	55.6
63	139.7	156.2	85.2	159.8	139.8	71.2	126.1	56.5
64	141.0	151.2	86.3	172.0	141.0	71.7	127.2	56.4

Year	Food	Clothing	Fuel and Light	Sundries	Total	Money Wages	Cost of Living	Real Wages
65	138.6	148.1	87.7	166.3	139.1	73.3	126.0	58.2
66	147.0	142.8	98.6	172.5	145.0	75.9	131.2	57.9
67	151.6	138.4	96.6	165.5	145.5	76.9	131.8	58.3
68	151.4	130.5	94.5	156.9	143.7	76.7	130.3	58.9
69	136.0	134.0	91.7	167.4	135.2	76.8	123.6	62.1
1870	135.1	128.4	92.4	151.7	131.0	79.0	120.6	65.5
71	141.9	126.3	90.7	151.8	134.6	81.0	123.9	65.4
72	144.9	134.0	105.7	159.2	140.0	84.1	128.7	65.3
73	141.8	135.1	121.2	157.7	139.7	86.8	129.1	67.2
74	136.0	132.2	104.4	123.1	130.5	88.2	122.0	72.3
75	129.9	133.3	97.5	120.8	126.5	88.1	118.8	74.2
76	132.7	124.3	96.3	114.6	124.3	87.7	117.0	75.0
77	133.2	119.9	92.5	109.9	123.4	86.7	116.1	74.7
78	128.2	114.1	83.6	106.5	117.7	82.8	110.7	74.8
79	123.1	107.0	81.6	100.9	112.4	83.2	106.6	78.0
1880	122.4	112.9	74.1	103.5	113.4	83.1	107.4	77.4
81	121.2	108.5	77.0	96.0	110.9	84.6	105.7	80.0
82	121.2	107.5	73.0	96.1	110.2	85.6	105.3	81.3
83	121.1	105.1	75.7	91.1	109.5	85.9	104.8	82.0
84	113.9	102.7	75.1	87.9	104.0	85.2	100.2	85.0
85	106.9	102.1	75.1	82.9	99.8	83.8	96.6	86.7
86	103.4	102.2	73.2	79.5	97.2	83.1	94.3	88.1
87	100.2	102.2	71.5	81.3	95.4	83.3	93.0	89.6
88	100.0	100.8	72.9	83.8	95.5	85.0	93.4	91.0
89	103.2	100.4	73.9	89.7	98.1	87.6	96.0	91.3
1890	101.6	101.8	79.6	95.6	98.8	90.8	97.2	93.4
91	103.7	101.9	78.2	88.1	99.0	91.1	95.8	95.1
92	103.9	101.0	77.7	80.5	97.9	90.5	96.4	93.9
93	99.3	100.3	84.5	80.5	96.2	90.5	95.1	95.2
94	94.9	99.1	73.4	75.8	91.3	90.5	91.1	99.3
95	92.1	97.8	71.3	72.5	88.7	90.5	89.1	101.6
96	91.7	98.6	72.1	73.9	88.8	91.1	89.3	102.0
97	95.5	98.2	72.6	72.4	88.8	93.1	89.7	103.8
98	99.5	97.0	73.3	75.3	93.4	93.3	93.4	100.2
99	95.4	96.2	79.5	84.3	92.7	96.0	93.4	102.2
1900	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
01	100.4	100.6	89.0	99.5	99.5	99.1	99.5	99.6
02	101.0	99.9	84.6	99.5	97.9	97.9	99.5	98.4
03	102.8	99.7	80.9	100	97.4	100	97.4	97.4
04	102.4	102.3	79.4	100	96.9	100	96.9	96.9
05	102.8	103.0	78.4	101	97.3	101	96.3	96.3
06	102.0	104.5	79.5	100.5	98.7	100.5	98.2	98.2
07	105.0	106.2	88.9	103	102.2	103	99.2	99.2
08	107.5	107.1	85.6	105	101.6	105	97.3	97.3
09	107.6	108.4	84.1	105	100.4	105	95.6	95.6
1910	109.4	110.7	83.8	106	100.8	106	95.1	95.1
11	109.4	112.4	85.1	106.5	101.1	106.5	94.9	94.9
12	114.5	115.5	87.0	110	103.7	110	94.3	94.3
13	114.8	115.9	90.7	111	106.8	111	96.2	96.2
14	116.8	117.4	92.5	115.5	107.8	115.5	93.1	93.1
15	147.4	142.3	115.9	135	119.7	135	88.5	88.5
16	180.0	183.7	127.7	161	130.2	161	81.1	81.1
17	223.3	241.5	137.8	194	167.0	194	86.3	86.3
18	241.9	262.8	165.3	223	209.0	223	93.6	93.6
19	246.4	422.6	183.4	236	233.0	236	98.5	98.5
1920	288.0	485.3	201.4	274	271.7	274	99.2	99.2
21	258.2	353.5	230.4	249	260.6	249	104.8	104.8
22	198.0	275.3	221.1	201	203.3	201	101.0	101.0
23	190.1	259.6	211.4	191	181.9	191	95.0	95.0
24	191.2	262.5	213.8	192	184.8	192	96.0	96.0
25	192.4	267.2	217.6	194	188.4	194	97.3	97.3
26	184.5	257.8	194.8	189	186.8	189	98.7	98.7
27	180.0	249.7	173.9	184	186.4	184	101.2	101.2
28	176.6	255.5	160.6	183	183.1	183	100.3	100.3
29	173.2	254.3	162.5	180	182.8	180	101.3	101.3
1930	163.1	246.2	163.9	174	182.0	174	104.7	104.7
31	147.4	228.7	165.3	162	178.2	162	109.9	109.9
32	141.7	220.5	163.4	158	174.6	158	110.2	110.2
33	135.0	214.7	161.5	154	173.7	154	112.8	112.8
34	137.2	217.6	161.5	155	173.9	155	111.9	111.9
35	144.0	215.8	161.5	156	174.5	156	112.2	112.2

the working class and has to be supplemented by statistics of mortality, health, education, housing, and employment and by non-statistical evidence.

Subject to these qualifications what does the index show? From 1732 to 1756 a downtrend in real wages, caused not by declining money wages but by increased costs of food and fuel. Clothing fell in price with the extension of the factory system, even before the introduction of steam or water-driven machinery.

From 1756 to 1793 the trend was horizontal, but after 1793 real wages fell rapidly, as war and fiat money made commodity prices rise. Peace and restoration of the gold standard raised real wages to the level that had prevailed from 1750 to 1780. Food went up much more than clothing during the war, as machinery reduced factory costs while agriculture continued to struggle against the law of diminishing returns as the population increased and the area of cultivation was extended to include inferior soils.

Money wages fell after 1815, but more slowly than the cost of living, with the result that real wages rose. By 1836 the downtrend of money wages was halted, but crop failures in 1839, 1841, and 1846 so raised the cost of living that real wages turned down again until 1847. Then began an uptrend in money wages that continued until 1873 without a setback and resumed its progress in 1887. Real wages, though interrupted by the Crimean War, rose rapidly after 1847, and unlike money wages did not react in the seventies and eighties. They reached a peak in 1897 that was not again attained until after the War. That peak was over twice the level of 1847 and over three times the level of 1800. But after 1897 money wages did not keep pace with the cost of living, and only caught up in the post-war deflation. Since 1929, on the other hand, money wages have not fallen as fast as the cost of living, and the index of real wages is now about 8 per cent above its 1897 peak. This difference is probably not enough to offset the higher rate of unemployment. On the other hand, the workingman, whether employed or not, gets much more from the public funds now than then, and working hours are shorter.

It is interesting to compare this index with the indexes of real wages in Sweden since 1860 and in this country since 1790—the only similar indexes of which I am aware.<sup>2</sup>

The long trend of real wages in England from 1791 to 1900 was not greatly different from the trend in this country. But the rise was more rapid in the United States before 1860, and in England after 1860.

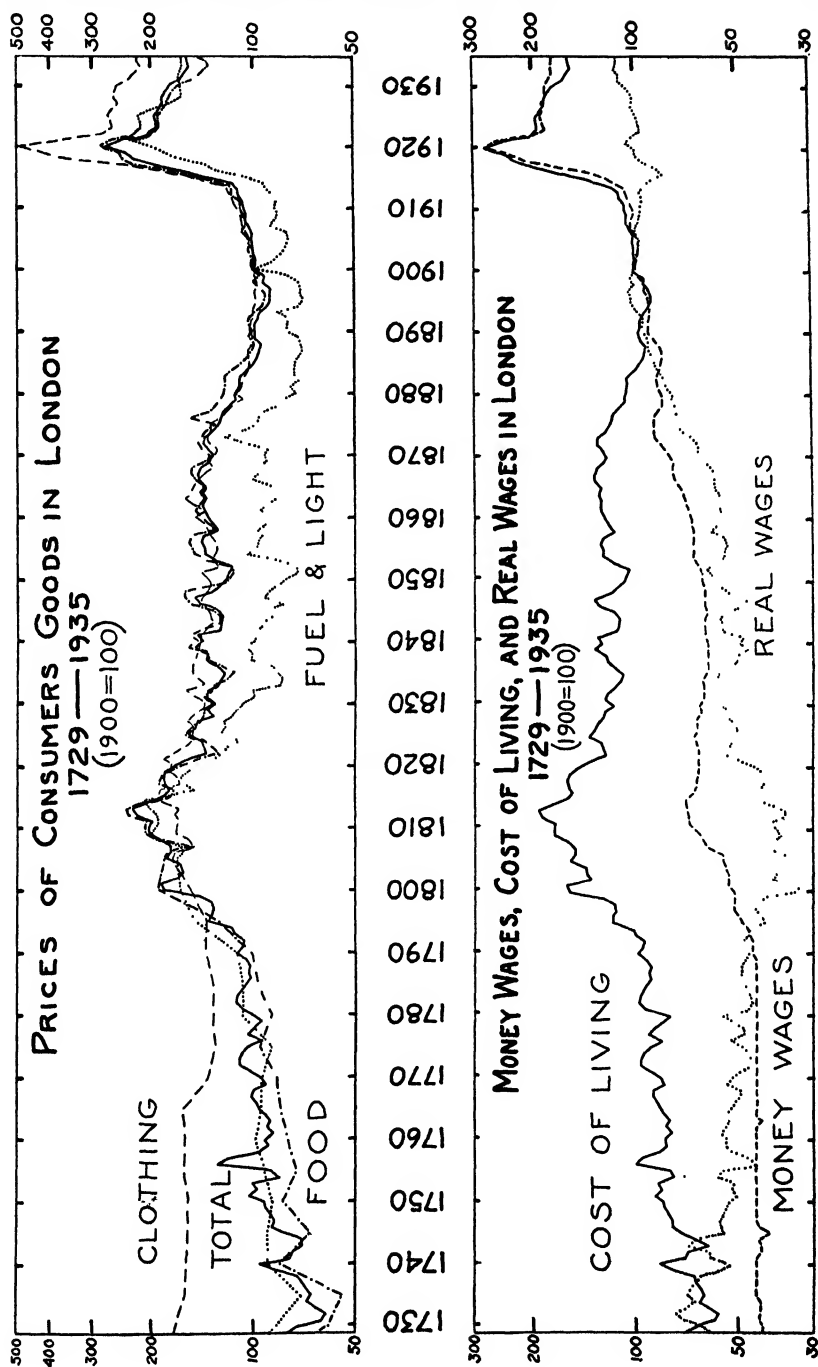
<sup>2</sup> G. Bagge, *Wages in Sweden, 1860-1930*; and an article by the present writer in *Review of Economic Statistics*, Jan. and Feb. 1934. (Vol. XVI, pp. 8-16, 25-27.)

Also there is a strong resemblance between the trend of real wages in Sweden and in England from 1860 to 1900. The lack of improvement since 1900 in England is, however, in striking contrast to the great increase in real wages here and in Sweden from 1918 to 1929.

Many conclusions may be suggested by a study of these indexes, and many explanations offered. One striking fact stands out and may be more than a coincidence. During the eighteenth century real wages in England declined. England like all of western Europe was ruled by a government that thought it its duty to control economic activities. The fashionable philosophy was in favor of economic planning. China was the model and inspiration for amateur social scientists because economic planning was supposed to have reached there its highest degree. Mercantilism was the creed of the business man, and the balance of trade was a constant source of anxiety. Nearly all branches of industry were closely regulated by law, except cotton manufacture. Under those circumstances the population increased, but the purchasing power of laborers fell to such a degree that it was probably no higher in 1800 than in the days of Diocletian 1500 years before. But cotton manufacture expanded and progressed.

After 1776 the up-to-the-minute publicists all came out for laissez-faire and by 1815 the new attitude had even come to pervade governmental and trade circles. Restrictions on industry and trade were gradually abolished, and the tariff was reduced, especially in 1846, although free trade was not finally introduced until 1860. A glance at the chart shows how rapidly real wages rose after that date.

Aside from the general trend of real wages shown by this index the most interesting feature is the timing of important recessions. Every recession was plainly more a result of rising costs of living than of falling money wages. In fact money wages rarely fell before 1921, and almost never as fast as the cost of living. On the other hand when the cost of living rose money wages almost always lagged behind, and real wages therefore fell. This was conspicuously the case during the early part of the Napoleonic and World Wars. Other periods of distress were caused by high prices of agricultural products occasioned by crop failures, especially in the nineteenth century. The last example of a real famine or an approach to one in time of peace was in 1847 when the index of consumers' goods was at its highest point between 1825 and 1916. After 1847 consumers' goods fell rapidly in price until 1852, and never regained their loss until the World War, although in 1866 and 1867 they came close to doing so. Prices of consumers' goods were apparently not affected by the gold discoveries. They were regularly much less affected by cyclical credit expansions than were the prices of raw



materials. In fact the movements of raw materials and those of finished goods differed greatly both in their fluctuations and in the slope of their trends. In 1782, for example, the first year for which comparisons are possible, the usual combination of Jevons' and Sauerbeck's indexes gives 162 as the level, if 1900 equals 100. This index of consumers' goods gives 111 for that year. At the peak of the Napoleonic period the Jevons-Sauerbeck index is 262, while this index is only 225. In 1849 the Jevons-Sauerbeck index is 107, while this index is 125. In 1873 the Sauerbeck index is 148 while this is 140. During the World War consumers' goods rose only two-thirds as far as raw materials, and since 1920 have fallen only two-thirds as far.

In conclusion I wish to state what seems to me to be the most important fact shown by the index. It is that while the purchasing power of laborers has been increased threefold or more since 1800, this increase has taken place almost entirely in periods when commodity prices were falling. All that increases in money wages have accomplished is to maintain those gains in part when prices rose again. This is statistical support for the thesis recently propounded by Dr. Moulton, that the aim of society should be to reduce prices, not to raise them. The essential soundness of this conclusion does not depend on the absolute accuracy of these statistics. It is supported by every index of real wages that has ever come to my attention. That being the case, I end with a prayer that the politicians who control our destinies may see the light and cease attempting to bring back prosperity by raising prices.

## PRICE STABILITY AND RESPONSIVENESS TO CHANGES IN THE PRICE OF GOLD\*

BY PAUL M. DENSEN

THE PURPOSE of this part of the general study of price reactions concerns itself with the answer to the question: Does the degree of stability possessed by the price of a commodity influence the responsiveness of its price to changes in the price of gold?

We shall define one or two terms before going further in order to avoid ambiguity later on. Commodity prices possessing the characteristic of flexibility are those having the ability to follow movements in the general price level over a period of time. A measure of flexibility would be the relative magnitude of price change of the commodity in a given period in which the general price level was changing rapidly. Those commodities experiencing little or no change in magnitude of price would be considered inflexible.

By contrast, instability or volatility of prices is measured by the *frequency* of price changes over a period of time. The greater the number of changes during the given period, the more unstable the price.

The prices we shall employ for analysis in this paper are those which are used in the Bureau of Labor Statistics Index of Wholesale Prices.

Professor Gardiner Means has shown that different commodities differ tremendously in price stability or volatility.<sup>1</sup> He has shown also that this factor is very closely correlated with the flexibility of the price of a commodity. The greater the flexibility or magnitude of price change, the more volatile and the less stable is the price. Mr. Wofsey and Mr. Shapiro have just told you of their findings which indicate that those prices which went down the most in the depression, were also the ones which recovered the most during the period when the price of gold was being changed by government action. In other words, those commodities possessing the greatest degree of flexibility responded most completely to changes in the price of gold.

The fact that stability is so closely correlated, although inversely, with flexibility, makes it difficult to determine whether or not volatility by itself makes the price of a commodity unusually responsive to changes in the price of gold. For example, does the fact that the wholesale price of California gasoline changed 86 times in the 94 months for

\* A paper presented at the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 31, 1935.

<sup>1</sup> Means, G. C. "Industrial Prices and Their Relative Inflexibility," *Senate Document No. 13, 74th Congress, 1st Session*.



which quotations were recorded, indicate anything about its probable reaction to changes in the price of gold? Did its tendency to hop up and down like a monkey on a stick tend to make it more responsive to the Administration's gold price policy?

In order to answer these questions it was first necessary to eliminate the factor of flexibility so as to permit the independent analysis of stability. This was accomplished by grouping the commodities into classes reasonably homogeneous as regards price flexibility. (The ratio of the average monthly price in 1932 to the average monthly price in 1929 was used as the criterion of flexibility.) The range permitted within any one class was 5 per cent. The commodities were distributed among five such classes, each with a different degree of flexibility.

A scatter diagram was then plotted for each of these five classes. In each diagram, the number of price changes in 94 opportunities for change was plotted on the horizontal axis against the ratio of the March 1934 price to the March 1933 price on the vertical axis, the latter being our measure of price change caused by the change in the price of gold—a change which took place between these two dates.

An examination of the five scatter diagrams leads us to the conclusion that there is not a sufficient degree of correlation present to justify any statement that volatility, or stability, of itself, is a determining factor to any appreciable extent in the responsiveness of the price of a commodity to changes in the price of gold.

There is a correlation present in Charts 1 and 2 that departs significantly from zero but we feel that it is not large enough to consider stability importantly related to commodity price changes due to changes in the price of gold. For the prices in Chart 1 this correlation is 0.397 and for the prices in Chart 2 it is 0.389. Such a correlation means that the variation about the regression of commodity price changes, due to changes in the price of gold, on stability is only 8 per cent less than the variation about the mean of the price changes. The variability of price changes due to changes in the price of gold, as expressed by the standard deviation, is twenty-two units and the consideration of stability reduces this variability only to twenty and one-quarter units. Such a reduction is not large enough, we believe, to justify any great weight being attached to the factor of stability.

Charts 3, 4, and 5 do not exhibit even the slight correlation present in Charts 1 and 2. It is fairly evident that in these three charts there is little relation between stability and price changes due to changes in the price of gold. Summarizing our findings in the light of the evidence here presented, we conclude that the degree of volatility possessed by the price of a commodity is not strikingly related to the responsiveness of that price to changes in the price of gold.

CHARTS 1-5  
INDIVIDUAL PRICE CHANGES MARCH 1933 TO MARCH 1934 FOR GROUPS OF  
COMMODITIES OF SIMILAR PRICE FLEXIBILITY BUT DIFFERENT  
DEGREES OF PRICE STABILITY

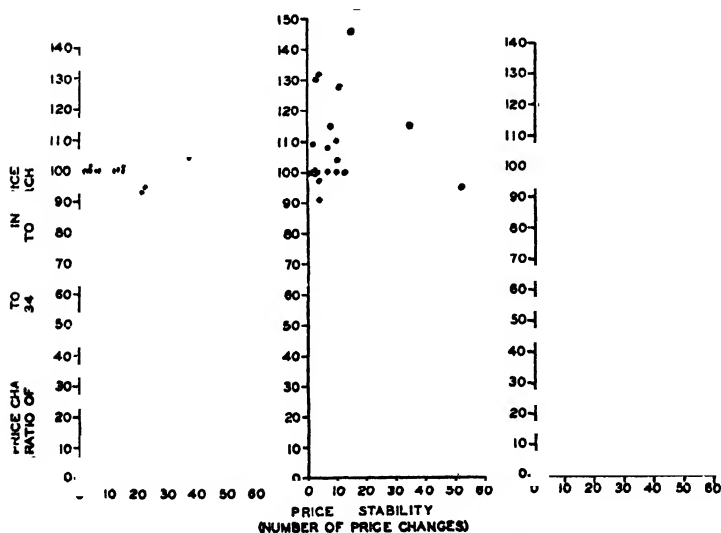
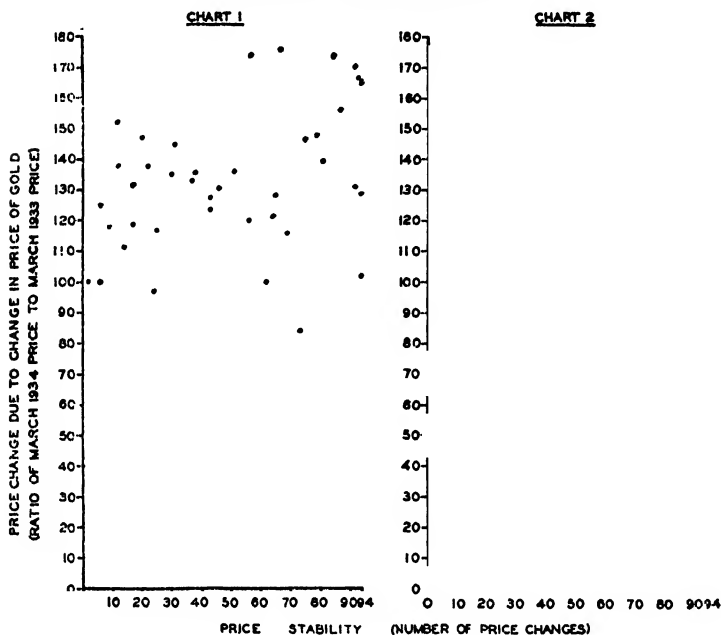


Chart 1 shows 41 commodities for which the ratio of average monthly price in 1932 to that in 1929 was between 60.0 and 64.9; chart 2, 44 between 70.0 and 74.9; chart 3, 40 between 85.0 and 89.9; chart 4, 26 between 95.0 and 99.9; and chart 5, 50 between 100.0 and 104.9.

## STATISTICS RELATING TO SECURITY MARKETS AND CORPORATIONS\*

BY PAUL P. GOURRICH, *Director of Research Division*  
*Securities and Exchange Commission*

**I**F I am not grossly to exceed the time allotted me for the discussion of the new statistical material which has become available to the public through the medium of the Securities and Exchange Commission, my remarks must necessarily be confined to a bare enumeration of materials collected, with a few comments on the nature and limitations of the more important series of this data.

The S.E.C., as you know, is a young agency. The fundamental desire of the Commission is to make available to the public statistical data of general interest as rapidly as is consistent with their nature—and it could hardly be otherwise, for full publicity is one of the surest means of achieving the major objectives set up by Congress. But since practically all of our series were started from scratch within the past year, we are still accumulating a considerable body of material which has not been made public because we wish to test its consistency and reliability before doing so.

Other consequences of our short span of existence are that we have not yet been able to utilize to the fullest all of the material which is made available to the Commission in the discharge of its administrative duties, and that there are still wide fields which we had to leave untouched because we necessarily must devote our attention first to those problems most essential to the current administration of the Commission. We hope, therefore, that we will be able to report a year hence almost as large a reservoir of new statistical information as we are reporting today.

Since the administration of the Public Utility Act of 1935 is still too much in its infancy to warrant discussion at the present, I shall consider only those statistics which have resulted from the administration of the Securities Act of 1933 and the Securities Exchange Act of 1934. The statistical materials will be discussed in the following order: I. Published Material; II. Material Not Yet Published; III. Miscellaneous Data.

\* A paper presented at the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 30, 1935.

## PUBLISHED MATERIAL

A. *Monthly Summary of Issues Registered under the Securities Act 1933.* This series—the backbone of the statistical work in the field of new issues of securities—is released about the 20th of each month and covers all publicly offered, non-exempt issues of \$100,000 or more, for which a registration statement became effective during the preceding month.<sup>1</sup> Up to November 30, 1935, 1,328 statements had been filed with the Commission covering new issues totaling \$4,085,819,000; 913 of these statements, covering new issues totaling \$3,508,727,000, became effective under the Act and are contained in this series.

Total effective registrations are divided into two groups: (1) the total for all issues intended in whole or in part for cash sale, and (2) the total for issues to be offered in connection with reorganizations, extension of maturities, and in connection with voting trust arrangements. The totals are broken down to show the distribution according to type of issue (common stock, preferred stock, debentures, etc.) and type of issuer (industry classification). For the first group only, expenses expected to be incurred in distribution (as estimated by the registrants) and the proposed uses of the proceeds are also given. This last item is of great importance, as it serves to indicate just when and by what amounts corporations raise new capital to be used for expansion of their plant and equipment.<sup>2</sup>

In connection with the use of this series it should be borne in mind that all statistics derived from effective registration statements refer to "registered intentions" to sell securities, and do not necessarily represent securities actually offered for sale or sold; and that they represent the registrants' estimates of expected proceeds and contemplated uses of the funds, rather than actual receipts and expenditures. The importance of this limitation is illustrated by the fact that a sample follow-up covering issues which had become effective in a single month (November 1933) disclosed that only a relatively small proportion of the total amount of securities registered had been sold within 16 months after registration. Although there are good reasons for believing that the discrepancy is very much smaller during the present refunding market, a warning must be sounded against using

<sup>1</sup> Securities issued by a common carrier subject to the provisions of Section 20a of the Interstate Commerce Act, bank issues, securities sold exclusively to persons residing within the state of organization of the issuer, securities placed privately, securities issued in certain types of exchanges, etc., are exempt under the 1933 Act.

<sup>2</sup> This release incorporates only a portion of the regularly tabulated material obtained from the registration statements. Within the Commission, the above data, and numerous other items of statistical interest, are tabulated into approximately 90 industrial and financial groups, according to the standard classification used by the Research Division in other studies.

registration statistics indiscriminately to represent or measure the actual volume of new issues absorbed by investors.<sup>3</sup>

B. *Monthly Summary of Trading on Exchanges Registered under the 1934 Act.* About the 25th of each month, the Commission makes public, for each registered securities exchange in the United States, the following data for the preceding month:

1. The number of shares sold, including odd-lots and stopped-stock;
2. The market value of such shares;
3. The par value of bonds sold, including stopped-bonds;
4. The market value of such bonds; and
5. The market value of all securities sold.

These data are reported by the members to the respective exchanges and by the exchanges to the Commission in order to provide a basis for the payment of the tax of 1/500 of 1 per cent on the value of turnover, introduced by Section 31 of the Securities Exchange Act, and cover the period from October 1934.<sup>4</sup> These monthly totals are of interest statistically because they embrace all sales and are, therefore, more comprehensive than "total reported sales"—the figure ordinarily given by newspapers and financial services.

C. *Monthly Summary of Transactions by Officers, Directors, and Principal Stockholders.* Under Section 16(a) of the Securities Exchange Act, officers, directors, and principal stockholders (i.e., persons owning beneficially more than 10 per cent of an issue of equity securities) of corporations with equity securities listed on a national securities exchange are required to report to the Securities and Exchange Commission every month each transaction in all the equity securities of such issuers.

In addition to reports on transactions, these persons are required to report their holdings (on Form 5) when the corporation becomes permanently registered on a national securities exchange (this happened for the majority of listed corporations on July 1, 1935); and (on Form 6) when they become an officer, director, or principal stockholder of the corporation. They must again report their holdings on Form 4 after every change in such holdings. The transactions and the holdings reported on Forms 5 and 6 (with the exception of the approximately 15,000 reports on Form 5 received in July 1935) have been published regularly since March 1935 in the "Official Summary" issued

<sup>3</sup> Another limitation is that the statistics of registrations from July 1933, to August 1934, inclusive, were compiled by the Federal Trade Commission (predecessor to the S.E.C. in the administration of the Securities Act of 1933), and are not comparable with the statistics for later months in all details. Upon taking over the work, the S.E.C. enlarged the scope of the tabulations and changed the method of grouping the proposed uses to be made of the funds. Although this change was made in September 1934, the releases of the Commission were kept on the old basis to the end of 1934.

<sup>4</sup> Similar data for exempt exchanges are also available, but have not thus far been released.

twice a month. Although this material lends itself readily to tabulation, statistical difficulties, some of which are mentioned in the following footnote, have thus far prevented the Commission from making public aggregate figures derived from these reports.<sup>5</sup>

#### MATERIAL NOT YET PUBLISHED

*A. Comprehensive Series of All New Security Issues.* Statistics derived from registration statements cover only a part, although a relatively large and important one, of all new issues offered in this country. We found the currently available series which purport to cover this field rather incomplete and unsatisfactory for our purposes, and consequently it was felt necessary to construct a comprehensive monthly series of our own for all issues of new securities. The series differs from those currently available particularly in that it (1) includes issues by the U. S. Treasury and its agencies; (2) attempts to include all private placings; (3) tries to distinguish sharply between issues offered for cash and issues offered for exchange or for other consideration; and (4) groups the total net proceeds in several broad categories according to their use, such as purchase of securities, purchase of other assets, expenditures on plant and equipment, repayment of funded debt, repayment of other indebtedness and increase of working capital.<sup>6</sup>

*B. Data Relating to Investment Banking.* An analysis of registration statements also provides us with information on the relation of investment banking to new security issues. Among the data derived are: (1) the type and extent of the banking commitment; (2) the cost of financing and the gross compensation of the underwriters; (3) the

<sup>5</sup> On the average, reports for about 1,700 transactions are received every month by the Commission. The reports not only state the date of the transaction and the amount of securities disposed of by the reporting person, but moreover give some indication as to the relationship of the reporting person to the corporation, the form of ownership and—what is more important—the type of acquisition or disposition reported. The characterization of the type of transaction by the reporting persons is, however, not always as clear as one might wish it to be and it is, therefore, sometimes impossible to distinguish with certainty between market transactions (i.e., purchases and sales on an exchange, on the over-the-counter market or through private deals) and transactions involving no cash consideration such as gifts, exchanges, liquidating dividends and the like. Another difficulty is presented by the fact that a number of transactions are reported by more than one person; this is the case, for instance, with acquisitions or dispositions by a partnership reported by every partner. Therefore, in order to arrive at correct totals it is necessary to eliminate these duplications; but inasmuch as the indications given in the report are not always unambiguous, such totals contain another, although probably not a very serious, source of error.

As for holdings, the S.E.C. is now engaged in the preparation of a "Census of holdings" which will bring together all the reports on Forms 4, 5, and 6, eliminating all but the most recent reports. The "census" will then give a picture of principal stockholders', officers', and directors' holdings in corporations with equity securities on a national securities exchange as of December 31, 1935. Later on we intend to make appropriate deductions for the self-ownership of American corporations (reacquired stock) as well as for inter-company holdings with a view of getting an approximate estimate of the net amount of securities outstanding.

<sup>6</sup> A variety of sources is utilized in securing these data. The data on private placings are based chiefly on questionnaires; those on issues of railroad securities are taken from the dockets of the I.C.C., and those on U.S. Government securities are supplied by the Treasury. For state and municipal issues we have to be content with the series commonly available. With respect to registered issues, only those are included for which there is a record of an actual public offering. This is a necessary statistical "deflation," resulting in the omission of small issues and sales of securities of investment trusts of the open-end type. However, these omissions are probably not so great as to affect the totals to any significant extent.

extent of the employment of and the compensation to dealers in selling the new issues; (4) the amounts of issues originated by or participated in by individual banking houses tabulated on a more accurate basis than that available in the past when participants were credited with the whole of any issue rather than with their respective shares.

C. *Statistics Relating to Corporation Finance.* The registration statements filed under the 1934 Act by companies desiring to list securities on a registered securities exchange afford an invaluable source of information about corporation finance. These statements are available to the public at the Commission's office, and at the exchanges on which the securities are registered. Among other things the registrant is required to give data on the following subjects:

1. Its sales of all securities within three years of the date of registration to any persons other than employees. The required information includes the title of the issue, the date of sale, the aggregate net proceeds, and the names of the underwriters, if any.

2. Information concerning options to which any of the registrant's securities are subject. The prices, expiration dates, and other material conditions relating to the exercise of these options must be described. Names and addresses of persons holding substantial interests in the total option must be given. The consideration for any option granted in the three years prior to registration must be specified.

3. From the majority of the forms for registration under the Securities Exchange Act we have, for the first time, a picture of the complete interest directors, officers, and principal stockholders have in their respective companies since, unlike reports under Section 16, they have to report not only their holdings of equity securities, but all other securities in registered companies of which they act as officers or directors or in which they own more than 10 per cent of any class of equity securities.

4. Some other subjects on which the registrant is required to file information are: (a) officers' remuneration and remuneration to employees who received over \$20,000 in the past fiscal year; (b) material bonus and profit-sharing agreements in effect at the time of registration; (c) general effect of all material management and general supervisory contracts in form providing for management of or services to the registrant or any of its subsidiaries, information which is of particular value in connection with public utilities and holding companies; (d) important details of material contracts with underwriters, directors, officers, or principal stockholders; (e) details of substantial changes in the registrants' or its subsidiaries' capitalization such as revaluations, adjustments of reserve accounts, restatements of capital

stock, transfers to and from surplus and write-offs; (f) balance sheets and income accounts.

The financial statements attached to the forms for registration under the Securities Exchange Act of 1934 and the financial statements which will be attached to the corresponding forms for annual reports just released or now in preparation furnish an almost unlimited field for the student of corporation finance, a field which the Securities and Exchange Commission itself has not as yet been able to explore, partly for lack of funds. A first attempt at tabulation and analysis of the annual reports for the fiscal year 1934 is about to be undertaken within the framework of a W.P.A. project—"Census of Listed American Corporations"—which is scheduled to be completed at about the middle of 1936.<sup>7</sup>

At the present time, the only regular statistics worthy of mention maintained by the Commission relating to corporation finance other than those arising out of the Acts are the quarterly earnings of about 300 registered companies, classified according to the industrial grouping previously mentioned. This classification has been carefully worked out with a view to securing a homogeneous functional grouping.

D. *Tabulation of Securities Traded on a Registered Exchange.* There is now in process a tabulation of all securities listed (and/or admitted to unlisted trading privileges) on all registered exchanges. It is intended that these lists will be reviewed once every three months, giving us a quarterly census of issues, by exchanges, by size, and by industries (and possibly also their total market price).

#### MISCELLANEOUS DATA

The staff of the Commission is continuously engaged in making more or less comprehensive studies on various technical studies which involve the use of new statistics, derived from field investigation or, in some cases, our own statistics. Among these we may note the following: (1) the study of reorganization committees, headed by Professor Douglas; (2) the relationship of pegging and stabilizing to overpricing; (3) options; (4) brokers' solvency; (5) over-the-counter markets; etc.

In connection with these and other studies, several interesting statistical series have been made available to the S.E.C. The New York Stock Exchange reports confidentially the total short position in each

<sup>7</sup> It is the hope of the Commission to make a regular feature of the tabulation of the annual financial statements, which although still far from being completely standardized, will be decidedly more amenable to comparison than the statements made public hitherto by the corporations. This would provide the investor and the student of corporation finance with detailed and extensive material, supplementing the statistics of the Bureau of Internal Revenue which, however, are set up with different purposes in view and therefore are not strictly comparable.



stock listed on the exchange as of the end of the month.<sup>3</sup> These data have been made available to us since July 1933. The Commission has also received various forms from the New York Stock Exchange and the New York Curb Exchange analyzing purchases and sales with respect to the principals involved and the type of transaction. Since the immediate purpose of these reports has been satisfied, they have recently been discontinued, but we shall probably receive some permanent information of this type in the future.

In addition to the above, there are other matters, in connection with which we are compiling information, either for eventual publication, or for use within the Commission. For the most part, these studies are being conducted with a view to making regulations as called for by the statutes.

While these data have been produced in the process of administering the Acts, particularly in connection with the drawing up of regulations, their economic by-products are multitudinous. To give a few illustrations: a study of salaries will enable us to get an idea as to the relation between the payment for managerial talent and total assets or gross revenues in various industries. Stock ownership data should shed light on the question of the extent of interest by officers in their own companies. Data showing trading practices will lift the veil of mystery from the trading process. In connection with proxies (Section 14 of the 1934 Act), we shall have data showing to some degree the extent of harmony or disharmony in corporate life, as well as the extent of ownership of groups intending to bring about a change in management. The periodic reports (Form K-10 and allied forms) will give us for the first time a conclusive picture of the periodic changes in American industry which will lend themselves to broad indexing, since our statistical material will be more or less homogeneous.

In closing, I should like to emphasize the importance of statistics of this sort. The information now available, when properly studied, should enable us to advance a long way in shedding light on our corporate life and in making the financial process less wasteful, more balanced, more responsible, and more orderly. As you know, one of the cornerstones of the 1933 and the 1934 Acts is disclosure. By improving and increasing the fund of statistical knowledge available to the investor, we are progressing towards a fairer financial process, are encouraging the formation of opinion based on facts and not on hunches, and are doing what we can to raise financial standards for the benefit of the investor.

<sup>3</sup> Both exchanges make public the *total* short position in *all* stocks on their respective exchanges as of the end of each month.

## SIGNIFICANCE OF THE LENDING FUNCTION OF THE FEDERAL RESERVE BANKS\*

BY E. A. GOLDENWEISER, *Director of Research and Statistics*  
*Board of Governors of the Federal Reserve System*

ELIGIBILITY of paper for discount at the Reserve banks sounds like a highly technical, uninteresting subject. It is a subject, however, that is not only of vital interest to banks at certain times, but one that may be used as a vehicle for expressing a broad general philosophy of banking and of the functions of a central bank. It is from that angle that I propose to approach the subject.

When the Federal Reserve System was established by the Federal Reserve Act in 1913, the prevailing conception of its function was that it was essentially an emergency institution. The Federal Reserve banks, by being given control of the reserves of member banks, were to be placed in a position to lend to these banks for seasonal and emergency purposes, and thereby to prevent periodical stringencies at crop-moving seasons and at other times, which in the past had caused currency and credit panics. The definition of the kind of paper that the Federal Reserve banks could discount was determined by this conception of the functions of the Federal Reserve banks, which is narrow even when viewed apart from the more general central banking duties of these banks. It is narrow even from the point of view of the lending function of the Reserve banks taken by itself. This paper is confined to a discussion of this phase of the Reserve banks' activity.

Limitation of eligibility had a threefold purpose: protection of the assets of the Reserve banks; limitation of the access to be had to these banks; and influence on the member banks in the direction of confining their activities largely to the acquisition of strictly commercial assets, rather than financing long-time enterprises, and particularly speculation. One of the objects of the Federal Reserve System was to prevent the use of member bank reserves in the New York money market, which was considered to be one of the causes of difficulties in earlier days. It is out of this conception of the Federal Reserve System and of the purposes of eligibility that arose the principle that paper in order to be eligible must be self-liquidating. Such paper must arise out of commercial transactions, the means of repayment for which would be

\* A paper read before the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 30, 1935.

the outcome of the consummation of the transactions for which the loans were made.

The function of eligibility in protecting the assets of the Reserve banks has proved to be essentially unrealistic. Strictly eligible paper can be as bad as or worse than long-time paper. The quality of the paper from the point of view of possible losses can much better be left to the judgment of the Reserve banks and the regulations of the Board, so that adjustments may be made in response to changes in economic and business conditions. The assets of the Reserve banks would be better protected by the provision that they must be satisfactory to the banks than by strict definition, which on the face of it would appear to relieve the banks of some of the responsibility for selecting acceptable assets. The Reserve banks, however, as a matter of fact have never felt themselves relieved of that responsibility, and experience has shown that they can be trusted to use good credit judgment in their operations.

A little aside from the main point of this discussion, but nevertheless not irrelevant, is the question of the volume of holdings of Government securities by the Federal Reserve banks. There is a school of thought that believes that it is bad practice for a Reserve bank to have large holdings of Government securities, and that great dangers are inherent in it. Those who take this point of view recall the great inflations which have been caused by governments borrowing from the central banks. The fact is, as this audience knows very well, that difficulties experienced by Germany and other countries through borrowing from the central bank by the government did not arise from the fact that the central bank held too many government securities, but from the fact that the central bank ceased to function as a regulator of the supply of credit and became an adjunct of the treasury in indirectly issuing fiat money. The real trouble was even deeper than that. It lay in the fact that the country was obliged to meet payments which it was in no position to meet. As a consequence, it had to print money either through the central bank or directly. The fact that it was done through the central bank did not change the ultimate result. It was bound to be inflation in any case. It may be said, in fact, that if inflation does not go too far, it is more likely to be arrested if the money is issued through the central bank than if it is issued directly by the government. A good example of that was war financing in the United States, where the money was raised in part through borrowings from the Reserve banks on the basis of Government obligations. The fact that the borrowing was on notes of the member banks with short maturities helped to bring about the subsequent liquidation.

The point I want to make in this connection is that the foreign instances quoted as horrible examples of inflation caused by a central bank lending to the government are irrelevant when applied to a situation like our own, where the Government's credit is firm, and where the volume of security holdings by the Reserve banks has been determined entirely in accordance with a credit policy adopted by the Reserve authorities for the purpose of encouraging recovery.

This is by way of an aside. Returning to the thread of my story, another purpose of eligibility has been to limit the amount of paper in the hands of member banks on which access to the Reserve banks could be had. This purpose the limitation has never served because at all times there has been vastly more eligible paper, even disregarding Government securities, to assure more access to the Reserve banks than has ever been needed. This statement, of course, applies to the aggregate and not to each individual bank. The principle was, in fact, abandoned when paper secured by Government obligations was made eligible. The reason why this purpose cannot be served by eligibility requirements is that the amount of eligible paper is bound to be plentiful at a time of credit expansion when restraint may be necessary, and the only time when it is likely to be insufficient is at a time when a deflationary process is in progress and when active intervention by the Federal Reserve banks is necessary. Eligibility requirements did not protect the country from the expansion either of 1919 and 1920 or of 1928 and 1929. But they did prevent the Federal Reserve System from coming to the assistance of many individual banks during the period from 1930 to 1932, when many banks were under pressure and had disposed of all of their eligible assets. During that period there were many banks that failed, though they possessed reasonably satisfactory assets, because under the law these assets were not eligible for discount.

This situation had to be met by the passage of the Glass-Steagall Act in 1932, which was at the time an emergency measure, but since has been liberalized and made permanent in the Banking Act of 1935.

The present provision of the law deprives of all significance the idea of limiting access to the Reserve banks by means of eligibility, because it authorizes disregarding eligibility at the only times when such eligibility may actually limit access to the Reserve banks for a considerable number of banks. The necessity for the abandonment of this reason for strict eligibility was made apparent during the depression, and it is safe to say that it will never regain significance.

The other object of eligibility, namely, to be an instrument for improving banking practices and encouraging banks to limit their activi-

ties to commercial paper, would be a more weighty argument, because it would serve a broader purpose, were it not for the fact that the purpose it wishes to serve is entirely unattainable and presumably undesirable in our banking structure. Banks cannot make a living by dealing in commercial paper alone. Such paper only constitutes about 8 per cent of their earning assets and there is not enough of it available to make a living for the banks. Whatever may be said of the desirability of a separation between commercial banking and investment banking, that is not what has emerged from our banking history, and it cannot be accomplished for the great mass of our banks so long as we have a large number of small banks which must serve all the needs of their communities. They could not make a living by doing only commercial business, nor in many cases by doing only investment business. They have to receive both time and demand deposits and they must invest their funds both in long- and short-time paper.

As has become generally known, and has been frequently pointed out, the method of doing business in this country to an increasing extent through corporations has resulted in large industries not borrowing to any considerable extent from the banks. Instead they sell their securities to the public, which in buying them not infrequently borrows from the banks in order to raise part of the purchase price. Whatever we may think of the desirability of this procedure, it is one that is well established and could not be changed over night. As a consequence, no encouragement to banks by means of legal technicalities to have commercial assets is likely to succeed.

The problem of the kind of banking we want to encourage has to be met on a broader front than that, and this would lead into a subject of much wider scope than I can cover here. Suffice it to say that in the immediate future the banks must serve the needs of their communities both for long- and for short-time money. If they do not, they will not regain the field of operation which they have lost to the Government, and on the contrary will continue to lose more. This would not present a bright future for the banks.

There has been a group of critics of liberalization of eligibility who are convinced that this would encourage member banks to make unsound long-time investments and thus contribute to the development once more of a situation like the one that brought the banking system low in 1930 to 1932. This criticism also arises out of an unrealistic approach. Besides disregarding the limitations of the influence of eligibility on the behavior of banks, it is based on the opinion that the dominant reason for the wholesale bank failures of the past fifteen years was mismanagement and unsound lending and investment prac-

tices. No one would contradict that both of these evils existed, but it is my belief that better bank management must be brought about through unification of banking, through increase in the banking unit, and through better supervision and more careful control of chartering. It cannot be brought about by strict eligibility, which has not prevented disaster in the past, and presumably could not do so in the future. The increased powers given to the Board to remove officers and directors of member banks and the additional powers contained in the Banking Act of 1933 and the Securities and Exchange Act of 1934 ought to make it easier to prevent unsound practices in the banks. It is through these channels that the influence of the Federal Reserve banks towards the maintenance of sound practices in the member banks should be exerted. Strict technical definition of eligibility is neither an adequate nor an effective means of control.

One of the lessons of the experience of the Federal Reserve System is that the Reserve banks should pay less attention to the assets on which a bank borrows and more attention to the bank itself, its management, and its policies. There is greater protection for the Federal Reserve banks and for the banking system as a whole in using the System's influence through its rediscounting function towards having the banks keep their houses in order along all lines than in requiring strict adherence to legal technicalities of the paper that will be accepted for discount. The Reserve banks, as a matter of fact, have practiced that from the beginning and the System could not have functioned if they had not done so. Official and legal recognition of this practice, however, constitutes a forward step.

In an economy like ours, where nine-tenths of the money is in the form of bank deposits, bank assets back of demand deposits represent the counterpart in the banks' portfolios of the nation's current operating funds. In such an economy a drop in the national income to less than one-half of its normal level must inevitably result in the destruction of a considerable part of the value of bank assets, and since the banks' liabilities are not thereby reduced, the total value of the assets would no longer equal the total of their deposit liabilities. With full recognition of the fact that a part of our banking trouble arose from mismanagement and speculation, it is nevertheless certain that the major part of the catastrophe, particularly after 1929, was not due to mismanagement alone, and in many banks was not due to mismanagement at all, but represented the effect on the banks of a collapse in the value of national wealth and income.

Against mismanagement the fight should be along the line of more careful chartering, better supervision, and administrative correction of

unsound situations. For losses in value of bank assets arising from the collapse of national income, the remedy is the avoidance of wide fluctuations in business activity. Whether such avoidance is humanly possible or not I am not prepared to say, but that it should be the object of central bank and fiscal policy cannot be gainsaid.

I am inclined to think that an ideal system would be if neither the banks nor their depositors were allowed to suffer from losses caused by national economic collapse, because such a collapse is brought about by forces beyond the banks' control. If economic stability were achieved, there would be no bank failures from that cause. Since it is too much to hope that this can be achieved in the predictable future, other means must be relied on for protecting the banks in emergency. They are, as a matter of fact, protected to a degree by the guaranty of bank deposits and they should in addition be protected by the readiness of the central bank to liquefy sound assets when a deflation is under way and there is no market for such assets. Assurance to the bank depositors that they will suffer no loss so long as their banks are soundly managed will prevent the recurrence of withdrawals of deposits such as swept over the country in the years 1931 and 1932. There might still be losses of deposits, owing to an unfavorable balance of payments in a given region, but mass withdrawals followed by mass bank failures should not be allowed to recur.

As I have said, the guaranty of bank deposits is one safeguard, but since that is limited to deposits of \$5,000, and since the worst difficulties arose from the transfer of much larger deposits, the main task of sustaining confidence and preventing mass withdrawals will continue to rest on the Federal Reserve banks.

This is not a radical doctrine. It is essentially what was done in countries that are often mentioned as examples of admirable banking practice, because they are said to protect commercial banks against unliquid assets. It is pointed out that these countries, notably England and Canada, have gone through the depression without bank failures. There is little question that at the depth of the depression the banks of Canada and of Great Britain would not have been in a position to withstand, without closing their doors, the kind of withdrawals that our banks had to meet. If that had happened, there would have been bank failures in England and Canada. The reason they did not occur was that the depositors did not withdraw their deposits, and the reason that they did not withdraw them was that they knew that the banks would not be permitted to fail. With all the banking concentrated in the hands of a small number of large banking institutions, it was general knowledge that neither the banks' competitors nor the govern-

ment would permit a bank to close its doors. Consequently, there were no wholesale withdrawals of deposits, and, as economic conditions improved, the assets of the banks rose in value, and the whole cycle was traversed without banking catastrophe.

The main purpose of this paper is to plead for recognition of the principle that so long as the assets back of the nation's current funds are not protected by the maintenance of economic stability, the banks must be carried over the abyss of economic depression by underwriting of their sound assets by the Reserve banks.

Recognition of the fact that the Federal Reserve banks may discount all satisfactory paper in case of need amounts to adoption of the principle that a central banking institution must do its share in helping the banks meet the consequences of national economic mismanagement. A full recognition of this principle and a policy consistent with it if boldly pursued should do much to prevent an extreme deflation, such as occurred in this country when the collapse of the banking system was an important contributory factor in the final phases of the deflation.

The question may be raised why it is that, if the failures were due to general economic causes and not to mismanagement, there were so many banks that have survived. Does that not mean that by prudent management any bank can be put in position to weather a storm? Far be it from me to deny that prudent management puts a bank in a better position to withstand a storm than does unwise management. But management, no matter how prudent, could not save a bank in a community whose income had been destroyed. And that is particularly true of a bank which has served the needs of its community adequately when the skies were clear. The answer is, therefore, that some of the banks that have survived are not banks at all but pawn shops or open-market investment houses. But there are others which have served their communities conscientiously and generously, and that have been managed wisely, and have survived. We congratulate them, but it is probable that their survival has been due in part to the element of luck. It may be that they happened to have customers in a line of industry that was not as hard hit by the depression as other lines, or that they had among their managers persons of independent wealth who were able to carry them over the worst period. There may be innumerable reasons for a bank's surviving, including help by the Government through the Reconstruction Finance Corporation or otherwise. There never has been a battle in which all the participants were killed, and those who have survived have not always nor necessarily been the bravest nor the strongest. They may not only be the



ones who ran away, but they may also be the ones whom the enemy fire happened to miss. The fact that many banks have survived is fortunate, but it is to be regretted that this fortunate fact should be used as an exhibit in condemning other banks which may have been managed as wisely and may have served their communities as well or better, but which were swept away by forces beyond their control.

A constructive program of banking would involve the solution of the problem of what kind of banks and banking institutions will best serve this country: whether one group or different groups; whether they shall be engaged in one line of activity only or in several lines; whether they shall be in large units or in small, and if in large, what should be the limits of expansion. These are vital problems; and perhaps the most vital one in this category is the necessity of putting all the banks under one set of rules and under one supervisory authority.

The object of my discussion has been to point out that, in addition to these structural improvements in our banking system, there is the necessity of protecting the banks in their operations under the banking system that now exists. Until we have learned to prevent economic chasms, we must be prepared to bridge them.

## DEPOSIT INSURANCE AS AN INFLUENCE FOR STABILIZING THE BANKING STRUCTURE\*

BY MORTIMER J. FOX, JR., *Chief, Division of Research and Statistics*  
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LIKE MANY social reforms Federal deposit insurance was provided in a moment of great popular demand for change without much serious thought as to its effects and implications. The economists, political scientists and statisticians of the country had neglected to give much consideration to the problems of deposit insurance prior to its inauguration. For the most part during the 1920's, and even up to June 1933, these groups looked upon it as an ill conceived scheme, not worthy of their attention. Since passage of the Banking Act of 1933 and since establishment of the Federal Deposit Insurance Corporation, these groups have been inclined to accept insurance rather passively. They have not made adequate inquiry into whether or not it has a legitimate permanent rôle in the financial system. It is time that such inquiry be made. Let us first inquire into the forces which brought deposit insurance into being and then discuss its possible effects. Finally we shall consider the nature of the more important incidental rôles of the Federal Deposit Insurance Corporation, as receiver and as a supervisor of banks.

It has been a traditional function of government in this country to undertake the supervision of the business of banking in the interest of depositors and other creditors. Whether directly or indirectly, it has been the effort of governmental agencies to establish means whereby depositors in banks will be assured of the reasonable security of their funds. Federal deposit insurance is a development of this general philosophy.

Proposals and attempts to grant special protection to depositors or note holders of banks have been frequent for many decades, both in this country and abroad. Over a hundred years ago the State of New York organized a safety fund system which was designed to guarantee the circulating notes of failed banks. The National Banking Act, like the preceding free banking systems of the various states, provided a mechanism for protecting the holders of circulating notes of banks. For almost 25 years the Federal government has operated a system

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designed to give special protection to depositors who place their funds in postal savings accounts. Many European countries have systems of protecting savings deposits which are comparable. Deposit insurance has been given repeated trials on a state-wide basis. Several insurance or guarantee funds for special classes of depositors or special classes of banks are in existence today.

Countries other than the United States have also engaged in practices which are comparable to the operations of the Federal deposit insurance system and which, for the most part, have resulted from the monetary and financial uncertainties following the World War. In their simplest form they consist of a state guarantee of deposits in certain banks. Such practices are consistent with the general assumption in European countries that large banks will not be permitted to fail at the expense of depositors.

In this country since 1864 and prior to the introduction of the Banking Act of 1933 over a hundred bills were introduced in the two houses of Congress which in some form or other called for Federal insurance or guarantee of deposits. These bills represented demands which received considerable support, particularly in the agricultural districts. However, it was not until the full effects of the industrial depression which followed the stock market collapse of 1929 had been felt that a really impressive demand for Federal insurance or guarantee of bank deposits appeared.

#### POLITICAL SUPPORT

The political support which made possible creation of the F.D.I.C. rested upon several bases. Since the banking system had collapsed, Congress considered it essential to take some action which would present to the public a tangible and fundamental change. Deposit insurance appealed to the legislators as fulfilling this need. It was believed that confidence in banks had been so shattered that as a prerequisite to general economic revival the public must be assured that in the future their funds would be safeguarded. It may be that general confidence was sufficiently established after March 1933 and that it was unnecessary, therefore, to create Federal deposit insurance, which was not to become effective until nine months later. But there can be no doubt that the desire to establish and maintain confidence was one of the principal reasons for the political support which deposit insurance received.

That support also rested upon a general desire to increase security and to reduce the economic uncertainties to which the vast majority of the population had been subjected. As an expression of this philos-

ophy Federal deposit insurance is a part of the trend toward social security legislation and toward the creation of agencies designed to establish some degree of stability in agriculture and industry. Finally, the support which made possible the passage of that part of the Banking Act of 1933 which created the F.D.I.C. represented a combination of those who wished to establish an organization for liquidating banks and for making immediate advances to depositors in banks which had already failed and those who wished to insure or guarantee depositors against loss in the future.

#### THE CORPORATION AS AN INSURER

Partly as a result of the political compromise which was reached when the Corporation was established and partly as a result of a certain vagueness of thought as to what might be accomplished by this agency, the F.D.I.C. as now constituted performs at least three distinct functions. First, the Corporation acts as an insurer or guarantor of bank deposits up to a maximum of \$5,000 per depositor in any one bank. Second, it may act and in some cases does act as receiver for insured banks which fail. And, third, it exercises supervision over insured State banks which are not members of the Federal Reserve System.

In its primary rôle as insurer the Corporation provides the vast majority of depositors in banks of the United States a degree of security which is socially desirable. Small capitalists are no longer subjected to involuntary sacrifices. Federal deposit insurance will in a large measure eliminate the unjustified losses to depositors which, for the 70 years 1865-1934, aggregated approximately \$3,500,000,000.

This very security has been the cause for some of the strongest criticism. It is popularly maintained that when depositors no longer have motives for choosing good banks as opposed to bad ones, there has been injected into the system an element of weakness. Without the incentive to satisfy the demands of depositors, bank management may be inclined to engage in unsound and speculative practices. It is said with uniform security extended to the vast majority of depositors there will be little reason for depositors to choose soundly managed rather than poorly managed institutions. In short, it has been said that insurance will operate to penalize the good banks by placing the poorly managed banks on an equal competitive basis.

These criticisms appear to be superficial for the following reasons. In the first place, information which is available to depositors does not show the true condition of banks. No supervisory authority has had as yet the legal power to require publication of statements which would

reveal the true net condition of a bank. But even were this information available, it is questionable whether depositors have either the inclination or capacity to discriminate between the well-managed and the poorly-managed institution, or, for that matter, to produce any significant influence on bank management. It is probably true that some risk-bearing is desirable from a social standpoint, in that it forces risk-bearers to make decisions. If the economic processes are to be successfully prosecuted, these decisions must be made. But the removal of the risk from the shoulders of small depositors who can ill afford the consequences of unintelligent decisions does not jeopardize the proper functioning of the economic system. In the second place, insofar as deposit coverage is limited, depositors who are not fully protected by insurance still continue to exercise as much influence over banking standards as has ever been the case. In the third place, it seems unreasonable to assume that, merely because of the advent of deposit insurance, bank stockholders no longer have an interest in the security of their investments. Deposit insurance has not significantly altered the influence of stockholders upon management.

Deposit insurance may reduce the severity of depressions. In the past the general public repeatedly lost confidence in banks, and runs upon them were frequent. As the public's fear for the security of their funds increased, banks found it necessary to place themselves in a more and more liquid position. In the attempt to shift and liquidate assets, markets became more and more depressed and the financial difficulties of the borrowers of banks increased. As a result, general business conditions became less satisfactory and the banks found themselves in a serious condition. Bank runs therefore have increased the cumulative forces of depression. Since the bulk of depositors are now secured by the F.D.I.C., the incentive for bank runs in all probability has been reduced. If the F.D.I.C. is successful in making bank runs a thing of the past, then it will be a factor in retarding the vicious circle of deflation.

It is well to consider, however, whether the destruction is caused by the withdrawal of a large number of small balances or whether it is caused by the "galloping" of the large deposits, not only from one bank to another but from one area of the country to another. The silent runs caused by withdrawals of accounts with balances of over \$5,000 may be a more frequent cause of the failure of an institution than the run which is brought about by the withdrawal of the small accounts of a large number of depositors. Then again with limited insurance large depositors may no longer have the incentive to protect local institutions for the benefit of creditors and borrowers alike.

The most important part of our circulating medium today is bank

deposits subject to check. Destruction of a part of this circulating medium contributes materially to the continuation and deepening of depressions. Circulating medium is destroyed through the call of loans and the sale of securities. Insofar as the activities of the Corporation will lessen the cause for dumping securities and collecting loans, they will have a tendency to reduce destruction of the circulating medium.

The depressing effect of bank failures upon individual communities is reduced through the operation of deposit insurance. Heretofore, the economic life of a community has been practically paralyzed by a bank failure which tied up its liquid funds. Today, when an insured bank fails, depositors in the institution receive their funds immediately from the reserves of the Corporation. Losses to depositors are no longer borne entirely by the local community. Receivers of failed insured banks find that liquidations of these institutions proceed more rapidly than they expected from their past experiences in this kind of work. They ascribe this improvement to the speedy payment of depositors by the insurance corporation.

The issues involved in the extent of insurance coverage have not been fully considered. The amount of coverage in itself is a debatable issue. Certainly there was no scientific basis for the selection of the present limit. It was agreed in general that the liability of the Corporation should be restricted but that the vast bulk of the depositors should be protected in full. It was believed that this would materially reduce the cost of insurance without substantially limiting its benefits. Under the provisions of the original Temporary Fund, insurance protection was provided up to \$2,500 per depositor. Statistics gathered at that time showed that probably 97 per cent of all the depositors were fully protected. Nevertheless, Congress deemed it expedient to raise the coverage to \$5,000.

While under the present limit by far the greater proportion of depositors are fully protected, the Corporation is probably not liable for more than 45 per cent of the total deposits of insured banks. As we have already noted, if the Corporation is to maintain confidence during times of depression and thus remove the necessity for cumulative liquidation, it may be necessary that large as well as small depositors be protected. Analyses made recently seem to indicate that since the failing banks are usually small and since almost all the deposits in these institutions are fully covered by insurance, the cost would not be materially increased if coverage were extended beyond the present limit. From a practical standpoint, however, it does not seem wise to extend the limits at this time for the following reasons: First, it cannot be assumed that only the small banks will continue to fail. Second, the

psychological effect of subjecting the Corporation to a risk which is over twice as great as that now assumed, without increasing its revenue or its reserves, may be undesirable. Third, deposit insurance on a nation-wide scale is an innovation and as yet experience in its administration is limited.

Up to this point we have referred to the business of the Corporation as deposit insurance. Let us consider briefly the nature of the risk which the Corporation assumes. Are these risks insurable? Can the protection which the Corporation offers to depositors be considered insurance? Can it be placed on an actuarial basis?

In the first place, the bulk of bank failures have occurred at unpredictable intervals. The "catastrophe hazard" in the case of bank deposits is so great as practically to preclude the possibility of genuine insurance. In the second place, because banking is peculiarly affected by economic and legislative developments, in a multitude of fields, it is unreasonable to suppose that the experience of the past gives any indication of what the losses to depositors may be in the future. In the third place, because the Corporation assumes risks which are concentrated in a comparatively small number of large units, and because frequently the failure of a large bank causes the failure of many small correspondent institutions, the distribution of its risk is not comparable to that of other types of insurance. In the fourth place, because the Corporation's source of revenue is in the nature of a tax, levied uniformly upon banks on the basis of total deposits, the so-called "premiums" bear little relation to the degree of risk assumed or the value of the insurance protection offered. In the fifth place, the Corporation has available to it the credit of the Government, without which deposit insurance would probably not be possible.

#### THE CORPORATION AS RECEIVER

The second basic function of the Corporation is its power or duty to act as receiver for insured banks which fail. For those national banks which are closed because of insolvency, by action of either the Comptroller of the Currency or local directors, the Corporation is appointed receiver. In some states the laws permit or require the appointment of the Corporation as receiver for insolvent State banks and the Corporation is authorized to act in this capacity when so appointed. In exercising this function the Corporation acts as an agency for salvaging assets in the institutions in which it has assumed and discharged its liability.

From the point of view of the Corporation it is important that it have considerable influence and supervision over the liquidation of the

assets of failed insured banks. In most cases, either the failing banks are small or the uninsured deposits have been withdrawn before the banks close with the result that the insured liability amounts to 80 or 90 per cent of the total deposits at the time of failure. The Corporation, therefore, becomes subrogated to 80 or 90 per cent of the depositors' claims, thus becoming by far the largest single creditor. Some practical problems in connection with the supervision or liquidation of such assets have developed. When the Corporation is not appointed receiver there is a possibility that the liquidation will be detrimental to the interests of the Corporation. A receiver appointed by the State authorities whose actions are reviewed by a local court presumably would have a tendency to favor the local debtor rather than a foreign creditor, particularly when that creditor is a large Federal corporation. On the other hand, where the Corporation is appointed receiver it becomes exceedingly difficult to manage the affairs in a manner satisfactory to the local supervisory authority—to avoid arousing antagonism on at least some of the multitude of details which must be worked out.

In the past, receivers have been under pressure from depositors to liquidate as rapidly as possible, no matter what the condition of the market for the assets might be. In many instances this necessitated substantial sacrifices on the part of depositors and had the tendency to add further deflationary forces to markets which were already depressed. Liquidation of certain assets may be postponed under the present system to the benefit of both the Corporation and general economic conditions. The Corporation can refrain from throwing on local and national markets those assets whose value would be maintained if for a time kept off the market. Such measures serve as a stabilizing influence. The potentialities which exist in a centralized and national agency designed to handle receiverships are worthy of further consideration, particularly as media for lessening the depth of depressions.

#### THE CORPORATION AS SUPERVISOR

The third basic function performed by the Corporation, and the one which actually occupies most of its personnel, is that of supervision of State banks which are not members of the Federal Reserve System. In fact, the bulk of the immediate problems with which the Corporation is faced has to do with bank supervision.

It is a postulate of American banking, conducted as it is under the unit system, that there be a substantial degree of governmental supervision over the operation of the individual units. Supervision of the



banking business seems particularly necessary since liabilities of banks constitute the major portion of the circulating medium and since it is difficult for depositors to determine the soundness of the depository institutions. There was danger that with the inauguration of insurance, supervisory standards of existing authorities would suffer, since in a large measure the responsibility to depositors has been shifted from these other authorities to the Corporation. Consequently it was deemed necessary that the F.D.I.C. itself set up a supervisory organization in order to guard against the lowering of supervisory standards and in order to reinforce and raise the existing standards. Since the Corporation has a direct financial obligation to depositors, it has a greater incentive for effective bank supervision than has existed heretofore in any governmental authority.

The Corporation's chief interest in supervisory powers is as a means of limiting the loss which it will be obliged to assume. For the time being, there are three fundamental methods through which the Corporation attempts to accomplish this purpose.

In the first place, the Corporation recognizes that a substantial local equity of net sound capital is perhaps the best way to reduce losses to depositors and consequently to the Corporation. The greater the capital cushion, the greater will be the protection to depositors and hence to the Corporation. For the past 70-year period, this capital cushion has been subject to a steady decline. The Federal supervisory agencies have been using tentatively as a rule of thumb a minimum ratio of capital to deposits of one to ten. Whether this ratio is adequate and whether it may be applied uniformly to banks in all geographic locations and of all sizes requires further study. There is reason to believe that a much higher minimum standard needs gradually to be set up. The tangible ways in which the Corporation has attempted to assure the adequacy of the capital structure of insured banks is as follows: Banks which become newly insured have been required to show this minimum capital ratio. Banks wishing to reduce their capital structures have been required to receive the Corporation's permission before taking action. Considerable pressure has been exerted by the Corporation to build up the capital structures of banks.

In the second place, the Corporation has been charged by Congress with the broad duty to take steps toward the ejection of a bank from insurance whenever it shall be found "that an insured bank or its directors or trustees have continued unsafe or unsound practices." To date the Corporation has limited its efforts in discharging this responsibility solely to State banks not members of the Federal Reserve System. Through the medium of direct examination the Corporation

undertakes to ascertain the adequacy of the banks' management, the extent to which the operations of the bank are within the law, and other factors which determine the Corporation's risk.

In the third place, the Corporation has been given considerable authority in connection with admission of banks to insurance. Congress has set definite standards by which the Corporation shall judge whether or not to admit a bank. The practical problems which are involved in formulating a policy for placing these standards in operation are many. The attempt to determine, for example, whether or not a small bank in a town of less than 500 population located perhaps 10 or 15 miles from an existing insured bank with a capital structure of 15 or 20 thousand dollars should be admitted to insurance presents problems of far reaching implications.

The means by which the Corporation will be effective in exercising supervisory influences are two-fold. In the first place, the Corporation actually has considerable power as a result of moral suasion. Banks are, on the whole, coöperative and their officers frequently see the practical aspects of the suggestions made by the Corporation and consequently put them into effect. In the second place, Congress has given the Corporation the authority, after due notice has been served upon the bank and upon supervisory authority, to expel from insurance benefits a recalcitrant institution. The threat of expulsion has been the most potent means at the disposal of the Corporation for enforcing its recommendations. The efficacy of expulsion as a means for enforcing standards set by the Corporation depends upon the importance which depositors attach to insurance. If a bank can live just as successfully without insurance, such means of influencing banking standards become valueless.

Finally there may be some basis for the contention that the agency which undertakes to guarantee deposits should not also supervise the insured banks. There may be danger that the Corporation will act too much with a view to its own pecuniary interests and not with a view to the general benefit of the economic system. There may be danger that the Corporation will exert its influence to keep insured banks from being declared insolvent in order that it may show a favorable financial record. The control which the Corporation can exercise may actually be no better than that which has been exercised by existing State and Federal supervisory authorities.

#### CONCLUSION

In conclusion we have seen that prior to the banking holiday bank supervision proved to be incapable of maintaining the security of de-

positors' funds. The F.D.I.C. was established to serve purposes for which supervision alone had proved inadequate.

There are three basic functions of the F.D.I.C.: first to act as insurer of deposits up to a maximum of \$5,000 per depositor and to spread the losses resulting from bank failures to the entire banking system and the taxpayers and away from the local community; second, to act as a salvaging agency in an attempt to get the maximum recovery out of assets in banks which fail and at the same time to cause the least damage and hardship to the economic structure; third, to act as a supervisory body in an effort to raise the standards of existing supervision and to avoid any relaxing of those standards.

In my opinion the F.D.I.C. offers potentialities which when developed may serve effectively to lessen the cumulative forces of depression.

# THE EVALUATION OF THE EFFECT UPON MORTALITY STATISTICS OF THE SELECTION OF THE PRIMARY CAUSE OF DEATH\*

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FOR ALMOST a century the nations of the civilized world have been working to develop a uniform reporting system for causes of death. As late as 1893, no two countries had attained complete uniformity of technique in their methods of statistical classification of causes of death. Since that time, the International List of Causes of Death has been established and adopted in most of these countries. More than one-half of the death certificates in the United States have on them two or more titles for cause of death. The tabulation of the multiple causes of death involving such a high proportion of the death certificates constitutes a major technical problem. Consequently, methods of procedures supplementary to the International List have been developed by this country to aid in the selection and tabulation of the primary or principal cause of death.

At the 1929 meeting in Paris of the International Commission charged with the decennial revision of the International List of Causes of Death, it was recommended that the United States Government, which had developed rules for codification and selection of such primary causes of death, be asked to take measures for the establishment of a code of general instruction which could be adopted by the countries using the International Nomenclature. Thus this country was given the opportunity to assume the leadership in this particular problem.

The problems involved with the selection of the primary cause of death are peculiarly complex and bewildering in character. The rules themselves, as expressed in the Manual of the Joint Causes of Death, have resulted from certain general concepts. These concepts in turn have arisen from the principles of nomenclature. Since there is no sharp line of demarcation between the problems involved with the selection of the primary cause of death and those inherent in the nomenclature of causes of death, the principles of nomenclature must be reviewed in a study of this subject.

Cause of death nosology is the basis of mortality statistics. Mortality nosology consists of four major divisions: definition of the disease

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entities; nomenclature of diseases or the assignment of appropriate names which are acceptable; classification of terminology in some methodical or convenient order; and adaptation of an appropriate coding system for the disease classification which will best serve the statistical function in the tabulation of data collected from the death certificates. The definition of a disease entity is the first function of medical nosology. At present the medical dictionary offers the only means to meet this need. In a subject advancing and changing with the rapidity of medicine, it is difficult to keep definitions abreast of new usage and significance. Not only is clinical terminology constantly expanding in the use of new terms but old words take on new senses, while others descend into disuse.

The selection of the best name for a given disease entity is the function usually ascribed to medical nomenclature. Differences of opinion exist as to the proper basis for selection of the best name. In view of the confusion existing in nomenclature and the passion for invention of new terminology, it seems advisable to effect, if possible, a systematic clearance of new names through some recognized central agency.

Classification of disease has been and continues to be a battle ground for the conflicting interests and desires of various medical groups. A great many classifications of disease entities have been used by the medical profession in the course of the last hundred years. Each has arisen from the desire to arrange the nomenclature in the most natural order possible for convenience and facility of usage. The selection of any one plan to the exclusion of all others must of necessity be artificial since it is arranged to elucidate or support a given theory or to attain a definite end. The progress of medicine will be advanced by establishing useful, broad classifications if the classification scheme itself is not allowed to throttle new attempts at reclassification and study. This end can be attained through a coding system built around groups of related terms. A satisfactory coding system must give full recognition to the following principles: it should permit a minimum of variation in judgment to the clerk assigning the code number to a given medical term; it should eliminate differences in coding to a degree of fineness the differentiation of which would lead to a conflict of opinion between physicians; it should be constructed around numbers grouping broad categories suitable for tabulation and comparison of mortality statistics; it should be adapted to the use of punched card and mechanical tabulation; and finally, it should permit almost unlimited expansion for new terms without the destruction or replacement of code numbers already existing for terms in active use.

To a certain degree the International List of Causes of Death is

involved with each of the four divisions of nosology: definition, selection of best name, classification, and coding. In the early consideration of the principles underlying the International List of Causes of Death, the alleged primary purpose of the Manual was to create a systematic plan for the issuance of reports on death, and a code by which comparability of international reporting might be maintained. Consequently, very little effort was expended in considering the definition of terminology, and practically no effort was made to obtain a proper nomenclature of disease from the standpoint of selecting the best name for any one disease entity. The proposal of the "Committee on the Accuracy of Certified Causes of Death," which was submitted to the Vital Statistics Section of the American Public Health Association in October of this year, recommended the adoption of preferred terms in the tabular portion of the International List. If this recommendation is accepted it is anticipated that these preferred terms will be printed in bold-faced type in the next edition of the Manual of the International List of Causes of Death, both in the tabular and in the index portions of the volume. The only other attempt to select most appropriate names for causes of death has been the establishment of a list of undesirable terms and an attempt to eliminate the common usage of such terms by reporting physicians.

No claim was made that the classification of the International List was to be considered a scientific classification of disease. Obviously some condensation of the thousands of medical terms was necessary in order to facilitate the compilation of the statistics of death. Such a list might be arranged or classified in any order. The order finally adopted in the List has the advantage of grouping together many causes which are frequently studied together. It is a practical working code whereby the statistician can assign medical terms reported by physicians as causes of death to more or less definite titles, representing, from the statistical standpoint, relatively homogeneous groups of diseases.

The International List and its usefulness must be judged primarily in the light of how well it serves its alleged primary purpose. Only in so far as it has established a high degree of comparability in death statistics will it have served this end. An excellent historical view of the development of medical nosology and the International List is contained in the Introduction of the 2nd edition of the Manual of the International List of Causes of Death. From among many systems of nosology, William Farr selected that proposed by Cullen and modified it for statistical purposes. This statistical modification was the framework for the first International List. The List was adopted for the first

time in Paris, in 1855, and has undergone successive decennial revisions since that time.

Comparability of the death reports from various nations has improved with each successive revision of the International List. Nevertheless, important differences in the statistics between countries have been present. Some of these differences arose from inadequacy of definitions and some from variations in assignment of colloquial terms in the index of the lists of various countries. In part, divergence has been due to the variation in the classification of Joint Causes of Death. Difficulties of tabulation make it advisable that only one cause be tabulated for any particular death. It is common practice for the physician to note two or more causes of death for a given case. These causes may be either related to each other or totally unrelated. According to the present practice only one of these causes can be recorded as the primary cause of death. In 1917, 35 per cent of the death certificates in the United States had two or more causes of death reported. In 1925, this percentage was increased to 45. In 1934, 69 per cent of the certificates in New York State were in this class. In those areas where the medical profession seems to be most progressive, the percentage of the number of multiple deaths is usually higher and the problem of obtaining a uniform method of selecting the primary cause of death is more acute. Without a solution of this problem international comparability of statistical reporting can never be achieved.

In the first Manual of International Classification of Causes of Death, 1902, five general rules of guidance were formulated, designed to assist the coder of cause of death in making decisions concerned with the selection of the primary cause of death.

These rules were:

- Rule 1. If one of the two diseases is an *immediate and frequent complication* of the other, the death should be classified under the head of the primary disease.
- Rule 2. If it is not absolutely certain that one of the diseases is an immediate result of the other, we must see if there is a very great difference in the gravity of the two, and classify the death under the head of the more dangerous.
- Rule 3. When among the two causes of death there is a transmissible disease, it is preferable to assign the death to it, for statistics of infectious diseases are particularly interesting to the sanitarian, and it is important that they shall be as complete as possible.
- Rule 4. If a disease whose evolution is rapid is given in connection with another whose evolution is slow, it is preferable to charge the death to the first.
- Rule 5. Finally, if none of the preceding rules is applicable, the diagnosis most characteristic of the case should be selected.

In 1909, the International Commission did not give especial consideration to the problem of Joint Causes, but at the insistence of

Dr. Bertillon it agreed that the above rules should be continued, and a special committee was appointed to report on the subject. Wide variations in the instructions employed in various offices made it apparent that a considerable factor of uncertainty existed in the statistical results when a large proportion of joint causes was involved. General rules such as the above could not insure identical compilations from the same material. Methods in the same office varied from year to year and the coders of the death certificates found it necessary to vary their judgments to meet this changing coding method.

In order to meet these needs, the Manual for Joint Causes of Death was developed by the United States. To date there have been three editions of this Manual. The first edition was in 1914. The original Manual was printed as proof, and the criticism of statistical workers was invited. The second edition, published in 1925, followed an ingenious plan proposed by Dr. Bertillon. In place of a cumbersome index, a definite list of decisions was given for any two titles or subtitles of the International List. The third edition of the Manual of Joint Causes of Death, an extension of this process, was published in 1933.

It is well to note at this point that there is no sharp line of demarcation between the decisions concerning priority of multiple causes of death by the Joint Cause Manual and the multiple causes listed arbitrarily under a single International List number in the index of the International List. For example, diabetes is coded as 59; gangrene as 98; and diabetic gangrene as 59. Such a combination cannot be separated from the diabetic group nor counted as a part of the cases of gangrene, yet the risk of death of diabetic gangrene probably differs from the risk in uncomplicated cases of either diabetes or gangrene. Hundreds of such combinations are printed in the index of the International List. Each combination represents a decision of the same general type as decisions which are made in conjunction with the use of the Manual of the Joint Causes of Death. The more or less arbitrary rules for selection stated in this Joint Cause Manual represent a direct extension of the relatively inflexible decisions concerning combination terms which already exist in the index of the International List. Since each foreign country constructs the index of the International List to suit its own purposes, such combinations in the index may be assigned to different code numbers by the various countries or may be considered as two separate terms and treated like multiple causes of death; that is, there may be entire lack of uniformity in the handling.

The United States from the beginning has taken a stand on the



policy of creating arbitrary rules for the selection of the primary cause of death as expressed in the Manual of Joint Causes of Death. It has tempered these arbitrary rules by building up a list of exceptions whenever the rules seem inconsistent either with the selection of the disease leading to the eventual cause of death or, if this cannot be determined, with the selection of the term which represents the greatest risk of death.

The opinion of the Registrar-General of England, which is concurred in by registrars in a number of other foreign countries, is that more reliance should be placed on the opinion of the certifying medical practitioner with the hope of eventually dispensing altogether with the arbitrary rules of priority.

The general discussion concerning the selection of primary cause of death is not complete without a statement concerning the attitude and work of Dr. Julius J. Pikler, Vice-Director of the Budapest Communal Statistical Bureau. In 1909 Dr. Pikler published his results on "The Budapest System of Statistics on the Causes of Death." He proposes an extension of the Budapest system which

. . . makes accessible the complete number of all causes of death occurring in the course of the year, whether independently or in combination, and on the other hand it furnishes a complete summary and a check upon the editing and arranging of the data and the choice which has been decided upon in the case of double or triple causes of death.

After a description of the technical tabulation methods involved in his plan, Dr. Pikler concludes with the statement that

The system is capable of complete accuracy since the data are subjected to thorough and expert examination and compilation; it shows all causes of death without exception, occurring in the course of the period under observation, and of course gives the full number of each one of them, thus including those diseases considered by the compiler (more or less incorrectly) as mere complications; it brings clearly in view the choice which the compiler has made in each individual case of joint causes of death, and hence makes possible a criticism of this choice, and enables one to judge the comparability of the statistics with earlier reports of the same bureau and with reports on the causes of death from other statistical sources.

The United States Division of Vital Statistics has published contributory tables of the multiple causes of death for the mortality statistics of 1917 and 1925. These tables deal only with the primary and first contributory causes of death and omit any information which might have been given on more than the first contributory cause. The first contributory cause was selected by the same rules established in the Joint Cause Manual which were used to determine the primary cause of death. In both instances the entire registration area was reported. These tabulations prove conclusively that no matter how the primary cause of death is selected, important data will be omitted

unless the contributory causes themselves are tabulated. The percentage completeness in the reporting of any cause of death as a primary cause is listed below for some of the more important diseases.

Cause of Death	Per cent of deaths coded as primary cause of death		Shift in per cent
	1917	1925	
Other diseases of heart	76.4	70.3	- 6.1
Other diseases of arteries	32.1	24.4	- 7.7
Senility	36.5	27.8	- 8.7
Bronchopneumonia	64.2	56.6	- 7.6
Chronic nephritis (incl. unspecified 10 yrs. and over)	76.3	80.0	+ 3.7
Cerebral hemorrhage	88.7	81.1	- 7.6
Congestion and hemorrhagic infarct of the lung	10.0	8.1	- 1.9
Peritonitis without specified cause	13.0	10.1	- 2.9
Cancer	99.8	99.8	0.0
Endocarditis and myocarditis	39.1	39.0	- 0.1
Lobar pneumonia	92.3	84.8	- 7.5
Paralysis without specified cause	42.3	40.6	- 1.7
Purulent infection, septicemia	14.9	12.2	- 2.7
Pneumonia (unspecified)	55.3	38.3	-17.0
Acute nephritis	49.6	43.0	- 6.6
Tuberculosis	99.2	98.8	- 0.4
Other diseases of the stomach (except cancer)	48.5	45.2	- 3.3
Congenital debility, icterus, sclerema	83.3	53.0	-30.3
Influenza (other and unspecified)	66.8	76.3	+ 9.5
Simple meningitis	30.4	29.6	- 0.8
Intestinal obstruction	63.3	56.7	- 6.6
Other diseases of the liver	53.2	46.6	- 6.6
Asthma	31.7	26.8	- 4.9
Other forms of mental alienation	29.8	24.5	- 5.3
Embolism and thrombosis (not cerebral)	39.0	28.7	-10.3
Infantile convulsions (under 5 yrs.)	26.4	26.9	+ 0.5
Anemia, chlorosis	59.5	57.3	- 2.2
Diarrhea and enteritis (2 yrs. and over)	69.5	62.8	- 6.7
Pleurisy	41.5	36.0	- 5.5
Gangrene	30.1	22.3	- 7.8

For instance, there were 58,979 death certificates in 1917 which contained bronchopneumonia as a cause of death. In only 37,879, or 64.2 per cent, was bronchopneumonia recorded as the primary cause.

From these data it is obvious that a knowledge of death rates derived solely from the primary cause of death cannot be complete. Although in some diseases such as cancer or tuberculosis it will be much more complete than in other diseases such as asthma and pleurisy. Moreover it is also evident that the relative number of certain causes of death coded as primary such as cancer and meningitis have remained about the same between the years 1917 and 1925, while other causes such as pneumonia and influenza have shifted sufficiently to destroy in part the comparability of time series comparisons.

Since the alleged purpose of the International List of Causes of Death and the Manual of Joint Causes of Death is to create a mechanism by which comparability of mortality tabulations may be maintained, this subject will now be summarized. A certain amount of incomparability of the description of cause of death has resulted and probably always will persist due to changing medical practice. As pointed out previously in this paper, the use of medical terminology is in constant flux. Variations exist in definitions and choice of nomenclature between physicians in different nations, different communities

and, to some degree, even in the same community. The science of medicine is ever changing, which means that new terms will be coined and new connotations of old terms will creep into usage with the passage of years. Habits and attitudes of the profession toward noting the true cause of death are yet other factors to be reckoned. For the most part these are a direct result of the physician's desire to protect the interests of his patient. It is difficult to evaluate the constantly shifting influence of changing medical practices on the comparability of cause of death statistics.

Comparability has been materially affected by variations in coding practices in the various offices of vital statistics. Many special decisions concerning the coding of mortality have been made during the past decade in the United States Division of Vital Statistics of the Bureau of the Census, as well as by various State Divisions. These decisions have involved the coding of causes of death by use of the International List and the establishment of the primary cause of death by use of the Manual of Joint Causes of Death. Variations between the coding carried out by State offices and the Federal Division of Vital Statistics on identical certificates varies as little as one-half of one per cent to as much as 20 per cent of the coded titles. The usual discrepancy would amount to about 10 per cent in the coding of all causes of death.

Dr. Murphy attempted to ascertain the amount of variation between the statistical offices of different nations. On July 8, 1935, he sent a list of causes of death taken from 1032 death transcripts to 46 nations. Each item on this list was involved with two or more causes of death. To date ten nations have answered his request and eight nations have indicated the code number which would represent their selection as primary cause.

Ceylon proves to be the nation coding most nearly like the United States, having 88 per cent of the primary cause selected as those coded according to United States rules of practice. The coding of these nations coincides with that of the United States in the following proportions: Ceylon, 88 per cent; Philippine Islands, 83; Canada, 61; Denmark, 58; Holland, 56; England and Wales, 53; Spain, 43; and Belgium, 43. Of the titles coded according to the United States practice, 11 per cent were so coded by eight nations, 40 per cent by six or more nations, 73 per cent by four or more nations, and 99 per cent by at least one nation among the eight.

Even more important than the necessity for obtaining comparability of statistics between nations is the urgent necessity of arriving at comparability from the standpoint of time trends in such data. The United States death rates from 1900 to date are broken in many

places by unexplained decisions. It is probably true that most of these decisions have resulted in cause of death codes which are more consistent with current scientific medical practice, yet each change has meant, to a greater or lesser degree, a loss of comparability with past time trends. As an example of the effect of such arbitrary decisions, the death rates per 100,000 between the years 1900 and 1910, for the titles "Lack of care" and "Congenital debility," are reproduced below:

Year	Lack of care (death rate per 100,000)	Congenital debility (death rate per 100,000)	Total for both titles (death rate per 100,000)
1900	16.3	24.5	40.8
1901	15.1	20.9	36.0
1902	15.7	21.6	37.3
1903	13.7	21.2	34.9
1904	14.4	20.6	35.0
1905	3.0	31.2	34.2
1906	.9	33.4	34.3
1907	.3	32.8	33.1
1908	.3	30.9	31.2
1909	.2	26.5	26.7

It is obvious in this particular instance that a decision was made involving the transfer of most of the deaths due to lack of care to the title of congenital debility.

Another example of the influence exercised by a contributory cause of death upon the significance of death rates computed on the primary cause, is seen in the reports following the "flu" epidemic of 1918. This epidemic resulted in excess mortality rates not only for influenza but for a number of other diseases. Interpretations of such death rates necessarily should involve a consideration of the occurrence and influence of influenza as a contributory cause to other causes of death which were tabulated as primary.

With each decennial revision of the International List many titles are shifted from one number in the tabular list to another number. In the fourth edition of this volume, twenty-eight pages of text are assigned to the enumeration of the changes in the detailed International List. It is true that many of these changes are trivial in character involving titles which are relatively infrequent. At times, however, the decisions have involved hundreds of cases which cannot be recompiled in any way even in coarser categories in order to compare statistics prior to 1929 with those of 1930 and later. An example of this type is the changes involved with coronary disease, embolism, and thrombosis. In 1929, titles 91b and 91c contained 23,407 deaths due to arteriosclerosis, and coronary disease, and title 92 contains 6,448 deaths due to embolism and thrombosis. It is impossible to compare accurately these data with 1930 statistics which group 9,438 deaths

due to coronary disease under title 94b, 21,868 deaths of arteriosclerosis under title 97, and split the deaths due to thrombosis and embolism between titles 99, 100, and 103.

In an attempt to create greater comparability of mortality statistics, both from the standpoint of geographical and time trend differences, supplementary instructions to coders of causes of death have been prepared in the Division of Vital Statistics of the Census Bureau. Effective with the release of these instructions early in January 1936, the rules stated will be adhered to strictly by the Division of Vital Statistics and no alterations will be made except by officially approved amendments. A preliminary draft of these rules has been submitted for criticism to many people in the last two months. They were approved on November 29 by a Subcommittee appointed at the direction of the Special Advisory Committee of the Division of Vital Statistics. Dr. Haven Emerson was Chairman of this Subcommittee. The other members invited to attend the November 29 meeting were: Mr. George H. Van Buren, Mr. John O. Spain, Mr. Thomas J. Duffield, and Dr. W. Thurber Fales.

It is recognized that occasionally this policy will result in misallocation of a particular primary cause of death. However, consistency in coding can be maintained only by following such a plan. The true significance of the primary cause of death which has been selected under the Joint Cause Manual and the rules contained herein, can be determined and measured only by actually tabulating all causes of death in a sufficiently large sample to measure the effect of the Manual of Joint Causes of Death on death rates which have been established on primary causes of death selected under that Manual.

Under the plan of coding for mortality statistics inaugurated by this Division for use during the year 1935, the number of causes of death are to be counted for each certificate filed, and this total is to be punched on the tabulating card in addition to the punching for the primary cause of death. Because of the widespread interest in maternal deaths, all causes, both primary and contributory, for maternal causes of deaths, Numbers 140-150, are to be counted, coded, and tabulated. This will be done for the entire registration area. Further, for the State of Maryland, all causes, both primary and contributory, are to be counted, coded, and tabulated.

It is hoped that the effect of the Manual of Joint Causes of Death on death rates which are established upon primary causes of death may be measured and interpreted on 1935 mortality statistics by an analysis of the following tabulations:

1. Primary Causes of Death as Determined by the Manual of Joint

**Causes of Death.** This is the customary tabulation presented in Tables 6 and 8 of the annual Mortality Statistics.

2. Enumeration of the Number of Multiple Causes of Death with Each Primary Cause of Death. This count of multiple causes will be carried as a nine-column tabulation after each primary cause of death and will serve to indicate the complexity in selection of the primary cause of death.

3. Multiple Causes of Death for All Maternal Deaths (International List Numbers 140-150) whether such deaths are primary or contributory. This tabulation is of particular interest to a large group of persons. It will serve as a mechanism to permit comparison of differences between the various States in their habits of reporting multiple causes.

4. Enumeration of all Multiple Causes of Death with each Primary Cause of Death in the State of Maryland. Maryland was selected because it has a small total number of certificates, because it involves a good division between city and rural and between white and colored, and because the standards are high from both the medical and vital statistics viewpoints. This tabulation will serve as a sample in which the multiple causes of death for each primary cause of death can be studied. Results in Maryland, together with the results of tabulations 1, 2, and 3, can be used to develop a correction factor for the interpretation of death rates in other States which are based solely upon the primary cause of death.

## NOTES

### THE PRESENT INTERESTS OF PHYSICISTS IN STATISTICS

In the preceding century it was not unusual to find physicists and astronomers contributing to statistical theory. As a matter of fact, the main exponents of applied probability were leaders in these fields. The names of Gauss, Bessel, Encke, Helmert, Maxwell, and Boltzmann are famous not only in physics and astronomy but also in the developments of the adjustment of observations and statistical mechanics. But if statistical theory was for a time the adopted child of physicists, it acquired means of locomotion and set up a separate household some years ago—not with hard feelings; on the contrary, with frequent exchanges of mutual benefit, powerful examples being the contributions of Ehrenfest (1880–1933) and of the astronomer Charlier (1862–1934).

As a result of this partial separation physicists as a rule can justly be accused today of using antiquated statistical methods. This might be considered natural; time is required for the dissemination of accomplishments on the frontiers of any subject. Many of the newer results in mathematical statistics have not yet been translated into the form and language of physics. Curve fitting, for instance, to a biometrician means the graduation of a frequency distribution; to a physicist it means the accommodation of a function to observed points in the  $xy$  plane. There is a good deal of ground common to the two problems, but the connections need to be illuminated. It is a pleasure to report that progress along this line is being made, and it seems likely that exchanges will soon take place to the benefit of statistics as well as physics.

In the past, courses in physical measurements have, as a rule, gone so far as to take up the matter of accidental errors and even to teach a little about probable error; sometimes a little curve fitting. It is of course highly desirable to go deeper into the subject, for if statistics is of valid application anywhere, it should be both valid and useful in many physical problems where it is a stranger today. A physicist should be prepared with an appreciation of statistical methods, for his work, some time or other, is sure to involve the description and interpretation of data. It is therefore gratifying to note that the Graduate Schools of the United States Department of Agriculture and the National Bureau of Standards now have courses in modern statistical theory especially designed for the needs of physicists.

For the physicist, the problem of several samples is frequently to decide what value may be given to some physical constant (speed of light, charge on an electron, etc.) in order that calculations can be made with it; this naturally involves the degree of confidence that may be placed in various ranges, and the detection of constant errors by a comparison of experimental

results from two or more laboratories. Birge and Menzel in 1931, in a statistical analysis of the data on the atomic weight of hydrogen, found that certain discrepancies could be explained by the presence of a hitherto unsuspected isotope of mass  $2H$ , present to the extent of 1 part in about 4500. Observers looked for it and found it, and were awarded a Nobel prize for doing so. This is but one example of the fruit of the statistical analyses that Birge has made from time to time during the past twenty years on the status of measurements on various important physical magnitudes such as the charge  $e$  of the electron, Planck's constant  $h$ , the ratios  $h/e$ ,  $e/m$ , the gas constant  $R$ , atomic weights, the ice point, the speed of light, etc., the main object being to point out discrepancies in experimental work on related quantities, or irrationalities in the supposed relations. This work has proved to be valuable in focusing the efforts of theoretical and experimental physicists where they are most needed. A number of perplexing questions have in this way been cleared up, and at the same time, increasingly reliable values of various physical constants have evolved.

The analysis of periodicities, together with statistical tests of their significance, has just undergone a thorough rewriting at the hands of J. Bartels. He and A. G. McNish of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington have developed elegant and powerful devices for dealing with periodicities and trends in geophysical and meteorological observations.

Considerations of causality have brought about in some quarters expressions of reluctance, amounting almost to mistrust, toward some of the newer methods of statistics. In this connection, the name of Norman Campbell of the General Electric Company, Ltd., of London, is perhaps most conspicuous. Having searched the new and even the old developments of probability with characteristic thoroughness, some physicists look askant upon some of the basic assumptions of statistical theory. It seems that no one has bothered to state carefully the assumptions underlying the application of sampling, and it is here that physics properly steps in. Going back to the foundations of the calculus of probabilities, physicists see the terms in the expansion of the point binomial and wonder by what mysteries these can be made into real sampling distributions. For example, it is true that 65.6 per cent of the value of  $(\frac{1}{2} + \frac{1}{2})^{10}$  is contained in the fourth, fifth, and sixth terms, but what of it? Of profound significance, we are told by the statisticians; *in the long run* out of 10 random throws of a perfect coin heads will appear 4, 5, and 6 times on an average of 65.6 per cent of the cases. Upon inquiring *how long is a long run?* and *what are random throws?* the physicist discovers that he has made a *faux pas*—such things just aren't discussed. He is perplexed as he recalls from the *Rubaiyat* of Omar Khayyam the lines

The ball no question makes of Ayes and Noes,  
But Here or There as strikes the player goes;

and wonders if Nature is different now and has become so considerate of man's incapacity to solve the differential equations of motion in the fall of



the coin that it dispenses results in accordance with probability calculations and thereby enables him to predicate upon ignorance.

The physicist has built up a causal world and is suspicious of any formulation that ignores the principles of his success. He realizes the futility of trying to predict rationally the throws of a coin or the outcome of anything left to chance, for in such problems the initial and boundary conditions of the problem are lacking so that a causal solution is precluded; and he is suspicious of any subterfuge based on ignorance. There are physicists who on this basis deny that  $n$  observations taken with a piece of apparatus is a statistical problem; they deny that there exists a parent population to be sampled, asserting moreover that even if there were, the mean of a sample of  $n$  observations need not approach the mean of the parent population or anything else as  $n$  increases, and similarly for statistics other than the mean; to maintain otherwise would contravene the principle of causality. There may be a hitherto unexplained point of philosophy involved; if so, it should be cleared up; until then the usual connotations of sampling distributions and statistical tests must be regarded as immature. This is a real issue, and the necessity of pressing the question is a contribution of physics to statistical theory. Already it has affected profoundly the physical theories of the universe so that we have now two views of probability, the subjective and the objective. Outstanding names in these developments are Bridgman of Harvard, Margenau of Yale, and Reichenbach of Berlin.

In the field of atomic physics it has been found expedient to give probability interpretations to the equations of quantum mechanics. It is important to note that here, as well as in the gas theories of Maxwell and Boltzmann, and in the theory of radioactive disintegration propounded by Bateman in 1911 and just this month generalized by Ruark, probability interpretations are upheld because, and only so long as, they lead *without fail* to experimentally verifiable facts. Thus in dealing with atomic phenomena, physicists use the word probability in a sense quite different from ordinary. For them the principle of causality is still the basis of science.

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### A CORRECTION

The article by Dr. Meyer and Dr. Deming in the last issue of the JOURNAL contains a printer's error. (See Vol. 30, page 673.) In equation (2) the numerators of the fractions following the first and last integrals should be interchanged, i.e., the first numerator should be "1" rather than " $a$ " and the second numerator should be " $a$ " rather than "1."

## STATISTICS IN CHINESE AGRICULTURAL RESEARCH

Agricultural research has made considerable progress in China during the last few years, particularly in relation to breeding work on wheat, cotton and rice. The University of Nanking has its department of agronomy, with experimental grounds outside the city walls and coöperative stations elsewhere. Assistance in the breeding and biometrical aspects of the work has been furnished by Dr. H. H. Love, of Cornell University, who has spent some years in China. On the economic side notable statistical survey work has been done by Dr. J. Lossing Buck, who is engaged at present on a nationwide land utilization survey. For an account of the work of this University and other bodies see T. H. Shen: *Application of Science to Agriculture in China*. (*Proceedings of the Fifth Pacific Science Congress*, 1933, p. 573.)

The National Central University, Nanking, has, like its independent neighbour, a department of agronomy and experiment station, while agricultural research work is also being done at Yenching University, Peiping, and the University of Chekiang, Hangchow, to mention only those places known to me by visits. This latter university is at present being assembled on a new site. The department of agriculture was the first to move into its new buildings, where a generous amount of space has been allotted for experimental work. Other developments that I can speak to concern experimental work on animals, carried out in Manchuria under the auspices of the South Manchuria Railway Company, and economic research at Nankai University, Tientsin, and at the Institute of Social Sciences, Academia Sinica, Peiping.

A knowledge of statistics is required for the reduction of the data of experimental work of all kinds, and particularly for the planning and carrying through of modern field experiments. A great step forward for agricultural research generally, and for statistical applications in particular, has recently been taken by the formation of a National Agricultural Research Bureau under government auspices. Handsome buildings have been erected at Shao-ling-wei, outside Nanking, and the Bureau is organized into a number of departments and adequately staffed with trained men and women. Dr. T. H. Chien, assistant director, organized in the autumn of 1934 courses of lectures and practical work in statistics open to workers from all over the country, including field workers from many coöperative experiment stations whose duty it will be to carry out experiments planned in Nanking. It was my pleasure to lecture to upwards of 250 students, drawn from nearly every province of China.

A statistical section of the department of agronomy has been set up under the direction of Dr. P. C. Ma, formerly of Cornell and Cambridge, England, and the first experiments are in progress on the 250 acre experiment ground adjoining the station. The aim of this section is to aid in the planning of field experiments along the best modern lines, and to provide the machinery

for statistical examination of the results. The section will also act in an advisory capacity to members of all departments on problems of a statistical character.

For the publication of scientific work done the Bureau has its own journal, *Agricultura Sinica*, and also puts out special publications. A number of good papers have already appeared, and they are without exception well printed and carefully edited, particularly with regard to the English typesetting, so often a stumbling-block to the Chinese printer. For the most part the papers are in English, with a Chinese summary, although they may be accepted in French, German, etc., or in Chinese itself, in which case they are provided with an English summary. The Bureau has a well-equipped library of foreign scientific journals and books, including many statistical publications.

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### MEETING OF THE INSTITUTE OF MATHEMATICAL STATISTICS

A joint meeting of the Institute of Mathematical Statistics with the Econometric Society and the American Mathematical Society was held at St. Louis on January 2. The program consisted of an invited address, Mathematical Theory of Index Numbers, by Professor Thomas Rawles, and the following additional papers:

1. On certain distributions derived from the multinomial distribution, by Dr. Solomon Kullback.
2. Convexity properties of generalized mean value functions, by Dr. Nilan Norris.
3. The frequency distribution for the mean of  $n$  independent chance variables when each is subject to the law  $y_0 x^{p-1} (1-x)^{q-1}$ , by Professor W. D. Baten.
4. On the admissibility of time series, by Professor Francis Reban.

### COÖPERATIVE RESEARCH ON PRICES

A conference to discuss possibilities and means of collaboration in price research was held at the National Bureau of Economic Research on November 29-30, 1935. The meeting was the culmination of a growing feeling that research activities in economics should be more closely coördinated. In 1934 and 1935 the National Bureau had invited representatives of universities and other organizations to conferences to help it map its research program. At the 1935 meeting discussion centered on possible modes of coöperation among research agencies. Two conferences were subsequently held at which it was decided to explore the possibilities of coöperative action in two fields: price research and research on national income. Consequently the National Bureau invited representatives from various agencies interested in price

research and the study of pricing problems to meet for the purpose of discovering the best means of furthering their investigations.

Current projects were summarized and the sections of the field in which more work needs to be done were discussed. It was agreed that an organization which should serve not only to provide information on price studies and developments in the field but which should also consider the formulation of a program of research would be most useful. One important means to real progress in price research was felt to be coöperation with accountants and production engineers for the improvement of cost records. This may well constitute the basis for a long-run program; meanwhile day-to-day problems press for solution. Accordingly the Conference on Price Research was formally organized as a continuing body composed of representatives of the participating universities and research agencies: Universities of Chicago, Pennsylvania, Minnesota, Harvard, and Columbia; Food Research Institute of Stanford University, U. S. Bureau of Labor Statistics, U. S. Bureau of Agricultural Economics, Central Statistical Board, National Bureau of Economic Research. Contacts will be made with other agencies, public and private, and it is hoped that other interested institutions may be added to the membership of the Conference. An Executive Committee was appointed, with the following membership: Anne Bezanson, J. D. Black, R. W. Burgess, F. B. Garver, Henry Schultz, S. W. Wilcox, F. C. Mills, chairman. The National Bureau was requested to serve as the agent of the Conference in receiving and handling funds.

The work of the Price Conference will be of two general types. On the one hand, its Executive Committee will, it is hoped, be able to serve as a steering committee, or general staff, on price research in the United States, in so far as this is possible on a basis of voluntary coöperation. In this capacity it has established a modest secretariat at the National Bureau to manage its affairs, to arrange for periodical summaries of work in progress, and to make available to the members of the Conference reprints of price studies and such basic data and derived measurements as may be secured and handled in this fashion. It will be the duty of the Executive Committee, moreover, to keep itself informed concerning all important research projects in this field in the United States, to provide, on request, advisory services in connection with these projects, to stimulate new projects by calling the attention of suitably placed institutions or individuals to fields inviting research, to explore possibilities for the interchange of personnel among its members, to arrange for the review and appraisal of the data used in price research, and to seek to improve such data through coöperation with federal and other agencies responsible for their compilation. With the coöperation of the important federal agencies and of leading university research groups already assured, the opportunities for extending and greatly improving research work in prices through this joint effort are very promising.

But it is not expected that the Conference will restrict its activities to such organizational and instrumental activities. The Conference, at its first meeting, favored positive action, in collaboration with engineers, managers

and accountants, in the study of actual price changes, cost movements and price-making policies in specific industries and in distributive enterprises. It was recognized that some of the gravest gaps in our knowledge of economic processes are due to inadequacies of data and of analysis respecting costs, prices, and pricing under the conditions actually prevailing in industry and trade today. No great centralized project, calling for large new grants of research funds, is contemplated in this field. It is expected that the investigation of price problems in industry and trade will be conducted coöperatively, by the groups affiliated with the Conference, and that several studies centering on specific industries will be financed by funds provided by the individual institutions. The Conference on Price Research is eager to promote such a coöperative attack upon problems of vital concern alike to business men and to economists.

Success in the study of the price problems of industry and trade will depend in large part upon securing the active coöperation of accountants, engineers and men actively engaged in formulating the price policies of American business enterprises. As a first step in this enterprise, the Executive Committee of the Price Conference proposes to call a conference of representatives of these groups, and of interested economists.

As circumstances permit, it is expected that the Conference will actively support other research projects. Meanwhile, it will attempt to give unity and force to the activities of research workers in this field throughout the country, and to stimulate the accumulation, on a broader and sounder basis, of the factual material essential to the success of such research.

### CONFERENCE ON NATIONAL INCOME AND WEALTH

Increasingly aware of the values that lie in its collaboration with other research agencies, the National Bureau followed up its conference on price research with one on national income and wealth. The primary task was to afford the students in these fields the opportunity of becoming more familiar with the work in process or contemplated at the various institutions of discussing the various conceptual and statistical problems raised by the current studies, and of arriving at a common opinion as to what projects relating to national income and wealth seemed most urgent and most practicable for coöperative attack. The conference was held at the National Bureau on January 31 and February 1, and included representatives from the Universities of Harvard, Chicago, Columbia, Minnesota, and Wisconsin; from the Central Statistical Board; the Bureaus of Foreign and Domestic Commerce, of Agricultural Economics, of Labor Statistics; Division of Research and Statistics of the Treasury; Division of Research of the Federal Reserve Board; Consumers' Expenditures Study of the Industrial Division of the National Resources Committee; and the National Industrial Conference Board.

Upon preliminary discussion, the problems in the field were grouped for more intensive analysis by three committees: one to deal with objectives, concepts and terminology; the second to explore questions of data and pro-

cedures, arising in the estimates of national income and related wealth items by industrial sources and by type of payment; the third to discuss areas of the income and wealth fields still largely unexplored, i.e. primarily distribution of income by size among individuals or families, regional distribution of income, and estimates of wealth and their different classifications. Each committee made definite recommendations, some of which are listed below. The first committee recommended the establishment of a set of bench-mark years (1899, 1909, 1919, 1929, 1935) for which specially detailed breakdowns of income and wealth estimates could be provided, these detailed estimates being intended as guides with which reconciliation could be attempted by students in the field. Another recommendation of the first committee was that, as part of a continuing organization, a section be provided to act as a clearing house for proposed terminology and concepts and schemes of classification. The second committee commented upon the inadequacies of the industrial and type-of-payment classifications now employed, and recommended a careful consideration of the problems of these classifications by a continuing coöperative organization. This organization should attempt to stimulate both the data-collecting authorities and students in the field to fill gaps or remedy inconsistencies in the currently available data; and to devote more attention to those parts of the economic system, such as government and finance, in which income and wealth estimates encounter especially acute conceptual problems. The third committee emphasized the importance of obtaining a reliable distribution of income and wealth by size among individuals and families continuous for a number of years, and the advisability of combining it with a regional classification. It called attention to the state income and other tax data available in the files of state agencies, and to other relevant data which are not regularly published by the authorities collecting them and recommended a preliminary exploration of these fields, prior to the organization of a coöperative research project that would attack the problems directly. These recommendations, among others, were adopted by the Conference after prolonged discussion.

Towards the ends of defining objectives, clarifying concepts, and making and stimulating studies in the field, a continuing organization, to be known as the Conference on National Income and Wealth, was set up on a basis similar to that of the Conference on Price Research, and for similar purposes. To carry these out an Executive Committee composed of Simon Kuznets, chairman; M. A. Copeland, W. L. Crum, Aaron Director, H. M. Groves, A. W. Marget and R. R. Nathan was elected.

## SPECIAL STUDIES ON STATISTICS OF INCOME

The Treasury Department is conducting a number of special studies, the results of which may be of considerable interest to students of the amount and distribution of the national income, corporate profits, and sources of individual incomes. These studies may be listed under three heads:

I. *Revision of Individual Income Tax Forms.* The Division of Research and Statistics, in coöperation with the Bureau of Internal Revenue, is studying the advisability of a revision of the individual income tax forms. The main objective, from a statistical point of view, is to provide a definition of net income for analytical purposes independent of the changing legal definition for tax purposes. In addition, such a change would eliminate the recurring breaks in the comparability of income statistics from one year to another, of which the most recent example relates to the amount of capital net gain or loss included in income for tax purposes.

The main problem is to determine what items to include in gross income and what deductions to make in arriving at net income, for purposes of economic analysis. The most difficult decision relates to the treatment of capital gains.

II. *Compilation of Hitherto Unavailable Data.* The Treasury has never compiled and published all the information contained in the income tax returns. Now and again some of the unpublished material has been utilized by special investigators, but this has involved going over all the records in order to extract the necessary data. A small portion of an appropriation under the Works Progress Administration is therefore being utilized to put much of the hitherto unavailable data in useful form. The work plan may be outlined as follows:

### *Corporations*

1. *Statistics of Income for 1933*, Table 13. Corporation returns by major industrial groups relating to income and tax items.

This table will be expanded to show identical data for 91 minor industrial groups in each of the 51 States and Territories.

2. *Statistics of Income for 1933*, Table 15. Returns of corporations submitting balance sheets for 1933 by major industrial groups, showing balance sheet as well as tax information.

This table will be expanded to show for the asset and liability items identical data for 91 minor industrial groups in each of the 51 States and Territories.

3. *Statistics of Income for 1933*, Table 16. Returns of corporations submitting balance sheets for 1933 by total assets classes, showing additional balance sheet and tax information.

This table will be expanded to show identical data for 21 major industrial groups.

4. *Statistics of Income for 1933*, Text table (page 33). Consolidated corporation returns for 1933 by major industrial groups, relating to income or deficit.

This table will be expanded to show items identical with Table 13 and with Table 15 for 91 industrial groups.

5. Compilation and publication of data on salaries and wages reported as a deduction on corporation returns on Lines 2(c), 5(a), 16 and 24, by 91 industrial groups. (Not now included in *Statistics of Income*.)

### *Individuals*

1. *Statistics of Income for 1933*, Table 9. Returns by States and Territories and by net income classes, giving number of returns and net income together with tax information.

This table will be expanded to include sources of income and deductions identical with sources and deductions shown in Table 6.

2. *Statistics of Income for 1933*, Table 4. Returns by States and Territories from the point of view of sex and family relationship.

This table will be expanded to show data by net income class for each State.

The foregoing outline applies only to 1933. There will be some variation of it with respect to other years, as identical detailed classifications and tabulating procedure did not apply throughout the years. It is not possible at this time to estimate the number of years for which the work sheets may be transcribed, but it is hoped to cover all years from 1926-1934.

III. *A More Comprehensive Presentation of 1934 Individual Income Tax Data*. With an appropriation from the Works Progress Administration, the Division of Research and Statistics is now carrying on a comprehensive tabulation of the 1934 individual income tax returns. It is well known that, at present, compilation of "Statistics of Income" is based on approximately 20 per cent of the returns showing net incomes under \$5,000, as selected by the various Collectors of Internal Revenue, and on all returns showing net incomes of \$5,000 and over. An incidental result of the study will be a test of the adequacy of the present method of selecting the sample each year, but more significantly, a special study will provide more detailed information than is now available on the distribution of income, and on sources of income and deductions.

1. Tables will be provided showing sources of income and deductions by income classes for counties and certain large cities similar to tables now published for the country as a whole.

2. Correlation tables will be provided so that frequencies of sources of income and deductions as well as frequencies of net income will be shown.

3. The income distribution will be presented in smaller class intervals than is now done—as small as \$100 for net incomes under \$3,500.

4. The capital gain schedules will be tabulated separately in order to



clarify the effects of the tax provisions on capital gains and losses in the Revenue Act of 1934.

5. The Division is attempting to classify all the individual returns according to occupations and industries. However, the nature of the information on the returns casts some doubt on the reliability of the final results.

6. Separate returns filed by husbands and wives will be matched in order to determine the sources of income on such returns and the effects of such separate returns on tax liability.

7. The partnership returns for the years 1931-1934 will be tabulated, and will be so classified as to conform (as nearly as possible) to the corporate returns.

8. The fiduciary returns for the same years will also be tabulated.

9. Tentative plans exist to make a special study of changes in the distribution of income of identical individuals for the period 1930-1934, and a study of identical corporations for the same period. If these plans materialize, special emphasis will be placed on the distribution of corporate income and changes in depreciation allowances.

10. To supplement its information on the distribution of income in the lower ranges, the Treasury is endeavoring to obtain a tabulation of State income tax returns in a few States where the exemptions are lower than they are under Federal laws.

Treasury Department

GEORGE C. HAAS

*Director of Research and Statistics*

## PLANS FOR A STUDY OF THE CONSUMPTION OF GOODS AND SERVICES BY AMERICAN FAMILIES

The need for an investigation into the manner in which American families spend their incomes has long been recognized, both by Government agencies and by private organizations. In 1929 the Social Science Research Council emphasized this need in its outline of a proposed study of "Consumption According to Income." During the past five years, the maladjustment between the nation's producing power and its actual consumption has stressed still further the importance of basic data on the consumption habits and needs of the population.

An extensive Study of Consumer Purchases, designed to furnish such data, is now being undertaken as a Federal Works Project. The plans for the investigation have been developed jointly by the Consumption Research staff of the National Resources Committee, the Cost of Living Division of the U. S. Bureau of Labor Statistics and the Economics Division of the U. S. Bureau of Home Economics, with the coöperation of the Central Statistical Board. The project will be administered by the Bureau of Labor Statistics and the Bureau of Home Economics. A Steering Committee, composed of representatives of the coöperating agencies, will guide and coordinate the study.

The data collected in the survey will be obtained in part through a short sampling schedule, covering a random sample of about 336,000 families. This schedule will provide information on family income during the past year, on the occupations of members of the family gainfully employed, on family composition and on type of housing. A longer schedule, covering information on expenditures and savings during the year, on ownership of important types of durable goods and on other aspects of consumption, will be secured from a controlled sample of about 53,000 families, drawn largely from the random sample.

From about 3,000 of the families included in the controlled sample, records of food consumption will be secured, to provide accurate data on the nutritive adequacy of the diet. These records will be kept for one week at each season during the year following the scheduling. They will be accompanied by records of the incidence of sickness of the members of the family, in order to make possible an analysis of the relation of diet and health.

The study has been planned from the viewpoint of the analysis of the data. At each step in the procedure, therefore, a selection has been made of the factors considered most significant in determining the consumption habits of the population, and the sample has been concentrated so as to permit clear-cut comparisons with respect to these factors.

### THE COMMUNITIES SELECTED FOR THE STUDY

In accordance with this policy, the communities included in the study

have been selected not to "represent" the country as a whole, but to make possible comparisons between different geographic areas, between different degrees of urbanization and, in the farm sample, between different types of farming.

The study will be restricted, in the main, to six areas of the country, each fairly distinctive and homogeneous with respect to geographic and cultural characteristics. These areas, and the States included in them, are:

1. The East Central area, including Illinois, Indiana, southeastern Michigan, Ohio, Pennsylvania, and southern Wisconsin
2. The New England area, including Connecticut, Massachusetts, Rhode Island, and Vermont
3. The Southeast area, including Alabama, Georgia, Mississippi, North Carolina, and South Carolina
4. The West Central area, including Iowa, Kansas, Missouri, and Nebraska
5. The Rocky Mountain area, including Colorado, Montana, Utah, and Wyoming
6. The Pacific Northwest area, including western Oregon and western Washington

In each of these areas, communities have been selected to permit comparisons of consumption patterns for five distinct degrees of urbanization—the large city, the middle-size city, the small city, the village and the farm community. In addition, two very large cities—New York and Chicago—have been included, to provide a picture of metropolitan living.

The range of population for each degree of urbanization has been restricted within fairly narrow limits, to make it possible to isolate the effect of this factor on consumption. The number of communities of each size range needed within an area was determined on the basis of the number of cases required for analysis by income, occupation and other significant factors, and the number of families of the desired types available in the community. One large city was found sufficient for each area, two or three middle-size cities, four or more small cities, and ten or more villages.

The size ranges of the communities selected and the total number of communities of each type are as follows:

	Number	Population Range
Metropolises	2	3,376,000–6,930,000
Large cities	6	253,000–302,000
Middle-size cities	14	31,000–72,000
Small cities	28	9,000–19,000
Villages	126	500–3,000

In choosing the particular communities to be covered in each area, the first essential condition was that they be located within the size ranges selected. The factor next in importance was that of obtaining communities representative of the economic activities of the area. In addition, various other factors were considered for each city—its independence of adjacent larger cities, its rate of growth, its density of population, the proportion of

foreign-born families, the percentage of families on relief, its inclusion in earlier studies of family living. The six large cities selected are: Columbus (Ohio), Providence, Atlanta, Omaha, Denver, and Portland (Oregon).

The farm sample has been selected to represent the major types of farming throughout the country. In all, fifteen farm types will be included, each type being distinguished by a high degree of uniformity in the kind and relative amount of crops or livestock and in the methods and practices followed in production.

The sample will be drawn from 18 rural sections within the six main areas covered by the study and from four sections located outside of these areas. In all except three of these sections, a village sample will also be covered, so as to permit comparison of consumption patterns under similar geographic environment.

#### THE CONTROLLED SAMPLE

The basis of the study is the controlled sample of families from whom the expenditure schedule will be obtained. This sample will be limited to families satisfying certain conditions and will be selected according to a prearranged plan, assuring for each community an equal number of families of each family composition type at each income level for each occupational group.

Such a controlled sample has four important advantages:

First, it greatly facilitates clear-cut analysis of the factors affecting consumption, by providing for an extremely homogeneous sample through the exclusion of families who would otherwise blur comparisons.

Second, it provides sufficient cases at the extremes without a needless number of cases for the modal groups. It thus secures, in an economical way, much needed information for the rarer occupational and income groups.

Third, it yields a more accurate estimate of the mean of the sample as a whole than would a random sample of the same size. The mean of a random sample is subject to errors of two kinds—errors in the values of the variate studied as well as errors in the distribution of families. The mean of the controlled sample, on the other hand, is very much less subject to the second source of error, since the distribution of families will be quite accurately known from the larger sample of families from whom sampling schedules are obtained.

Fourth, it provides more reliable results than a random sample of the same size, for those analyses of the data in which regression lines are used, since a regression coefficient derived from a controlled sample has a smaller standard error. This is a result of the more even distribution of the observations from the controlled sample.

The conditions which a family must satisfy in order to be eligible for the controlled sample fall into two groups: the basic controls, including those factors whose influence it is desired to isolate, and the minor eligibility requirements, including those factors whose influence it is desired to eliminate in order to purify the sample.

The basic controls are:

1. *Nativity and Color.* The sample is largely restricted to native white families. Negro families, however, will also be included in all of the cities and villages in the southeast area, in four of the five farm sections in this area, and in New York City and Columbus, Ohio. The inclusion of the negro sample will make it possible to analyze the differences in the consumption patterns of white and negro families, as well as to compare the consumption of urban and rural negroes in the South with that of the negro in the North.

2. *Occupation.* The sample will cover the following seven occupational groups: wage-earners, clerical workers, other salaried workers (both professional and business), entrepreneurs (both professional and business), retired persons, farmers in villages and farm operators. The sample of retired persons will be included only in the East Central area. It is also planned, if time permits, to obtain data from a sample of families who have been on relief.

3. *Income.* The range of incomes which will be studied has been selected separately for each occupational group for each degree of urbanization; in each case the incomes selected will cover the entire range within which it seems feasible to seek sufficient cases for statistical treatment. Intervals of \$250 are used for annual incomes of \$2,500 or less, making ten classes; from \$2,500 to \$5,000 the step interval is \$500, making five classes; between \$5,000 and \$10,000 there are two classes, each of \$2,500 range; and between \$10,000 and \$25,000 there are three classes, each of \$5,000 range. Thus there are 20 income classes altogether.

4. *Family Composition.* The number of family types covered is different for different communities. In most of the communities the sample will cover five family types, ranging in size from two to six persons and including only "normal" families—that is, families with a husband and wife. One group of communities, located mainly in the East Central area, has been selected for a detailed study of the influence of family composition on consumption patterns. The sample for these communities has been intensified by including two additional family types, one with five or six persons, the other with seven or eight persons, and by providing for a larger number of families per type. In three large cities single individuals will also be sampled.

The size of the controlled sample is dependent on the number of cases in the final breakdown or "cell" composed of families of a given income class, occupational group and family composition type, living in a given type of community. In the non-intensified communities 30 families covering five family types, with six cases of each type, will be obtained at each income level. In the intensified area the number of cases has been increased to 70 at each income level, with 10 cases for each family type.

The number of cases needed in each cell for analysis of the influence of the factors affecting consumption was decided on after a careful study of available data. It is expected that the averages for the 30 cases at each income level in the non-intensified areas will be sufficiently reliable for the major groups of commodities and services and possibly for some of the individual items. For most of the items, however, it will be necessary to pool adjoining cells. In the intensified area the averages for the 70 cases at each

income level will be sufficiently stable for most, if not all, of the individual items, but for analysis by the separate family types it will ordinarily be necessary to combine adjoining cells.

Of the total number of families included in the controlled sample 34,000 will be from the urban, and 19,000 from the rural communities.

#### THE RANDOM SAMPLE

The random sample of families from whom the sampling schedule will be obtained forms a very valuable adjunct to the controlled sample. It greatly facilitates the selection of the controlled sample and it provides information on the distribution of families by income, occupation, and family type which is extremely helpful in the interpretation and analysis of the more detailed data collected from the controlled sample.

The random sample will be restricted to the nativity and color groups included in the controlled sample. It will include, however, all income levels, all occupational groups and all family composition types. In the farm sections it will include only families engaged in the type of farming the section was selected to represent.

The size of the random sample has been determined by the requirements that it furnish most of the controlled sample, that it yield reliable weights for use in computing estimates of the total consumption of the groups studied, and that, for ease in sampling, it cover a simple percentage of the total number of families in each community. On the basis of these considerations a total sample of 233,000 urban and 103,000 rural families has been decided on. This provides for a 5 per cent coverage in New York, 10 per cent coverage in Chicago, 25 per cent coverage of the large cities, 30 per cent coverage of the middle-size and small cities, 90 per cent coverage of the villages and 25 per cent coverage of the farm sections. The percentages refer to the number of families of the nativity and color groups included in the random sample in each community. The more complete coverage of the villages was decided on because of the lack of available data on the composition of villages.

#### SAMPLING PROCEDURE

Theoretically, the best sampling procedure for the purpose of the study would be to canvass each community first with the sampling schedule and then to select each cell of the controlled sample at random from the sampling schedules which have been classified into the desired breakdowns. This procedure, however, has practical disadvantages resulting from the fact that a period of one or more months would be required to obtain the random sample of the desired size. The random sampling period will, therefore, be divided into two or more periods, each of which will be followed by a period in which expenditure schedules will be taken.

In communities where a native white sample only will be obtained, no sampling will be done in sections which are predominantly negro or foreign-born and where the number of native white families is too small to compensate for the cost involved in sampling them. Similarly, in the farm sec-

tions, no sampling will be done in those parts which are characterized by a type of farming other than the one studied in the particular section.

A report card will be filled out by the enumerator for every family that has been approached and a record of all refusals will be obtained. It will thus be possible to test the randomness of the sample and to detect any bias in the sample due to the unwillingness of certain population groups to cooperate.

It is expected that approximately 80 per cent of the controlled sample will be obtained from the random sample. The remaining 20 per cent will be obtained by stratified sampling, the characteristics of the stratification depending on the types of families which have not been obtained in sufficient numbers from the random sample.

#### TABULATION AND ANALYSIS

For both samples covered by the study the basic cross-tabulations are determined by the controls of the sample of families from whom the expenditure schedules are taken.

Since the controlled sample is random only within cells but not as between cells it is not possible to reclassify the families by criteria other than these controls. Within each cell the number of cases is so small that additional cross-tabulations will not be feasible.

The random sample must be cross-tabulated in such a way as to yield the weights which are necessary to combine the results from different cells and thus to reconstruct the consumption of different groups of families from the data obtained from the controlled sample. This means that the basic cross-tabulations must be the same as for the controlled sample. However, due to the larger number of cases within a cell and to the completely random nature of the sample, additional tabulations can be made. These will include tabulations within the basic controls as well as re-sorts of the whole sample for special analyses.

The analysis of the data will largely be concerned with the measurement of the influence of the factors affecting consumption patterns. Thus the relationship between the expenditures on individual commodities or groups of commodities and family income will be derived for each occupational group, while holding family type constant. The results will then be compared for the different occupational groups to determine whether occupation affects the relationship between income and expenditures. Similar comparisons will also be made between degrees of urbanization and geographic areas.

The aspects of family living other than expenditure will be analyzed to show the variation between different groups of families. Special analyses of the influence of family type will be made with the data secured in the intensified area.

Consumption Research Staff  
Industrial Section  
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## PROGRESS OF WORK IN THE CENSUS BUREAU

### A TEN-YEAR PROGRAM FOR THE CENSUS BUREAU

The time is near at hand when legislation must be enacted providing for the next decennial census, to be taken in 1940. There is need also for a revision of the legislation regulating and defining the intercensal and current work of the Bureau. That being the case, the Bureau has had under consideration a plan for a single comprehensive bill codifying the existing census laws and providing at the same time for a unified ten-year program of census inquiries. The fundamental idea is to have comprehensive statistical surveys every fifth year and limited compilations of data every year. Most of the comprehensive censuses now conducted by the Bureau are on a decennial basis. Two, however, the census of agriculture and that of electrical industries, are already quinquennial; and one, the census of manufactures, is biennial. Under the proposed plan most, if not all, of the principal censuses would be placed on a quinquennial basis, and be supplemented by annual compilations of limited scope to bridge the gap between the quinquennial inquiries.

One objective of the plan is "to time and coördinate census inquiries so that those which are most closely related in subject matter or in organization of the field service may be conducted together" or in the same year. It is pointed out that there are two main groups of inquiries: one, economic relating to business or industry, and the other, social or demographic. It is proposed that the major social inquiries, including the census of population, be conducted in the years ending in 0 and 5, and the economic inquiries in the years ending in 2 and 7. This plan, it may be noted, contemplates a quinquennial census of population and does away with the present biennial census of manufactures, replacing it by a quinquennial census. The census of agriculture would be included with the census of population because of the close association of the field work of the two censuses.

The plan is designed "to attain greater administrative efficiency in the Bureau of the Census by the spreading of the major inquiries throughout the decade and the instituting of annual series linking the general censuses thereby attaining a more even work load." No other public agency is subject to as extreme fluctuations in personnel and activity as the Bureau of the Census. In the period of the decennial census the office force increases from a normal of about 800 employees to a peak of about 6,500. The new plan would reduce the decennial peak, or rather substitute for it smaller quinquennial peaks.

The Census Advisory Committee at its meeting in November after considering this plan adopted the following resolution:

**RESOLVED** that the Committee favors a quinquennial census covering population, agriculture, and such other related subjects as it may be desirable to include, scheduled for the years ending in "0" and "5"; also a quinquennial census of manufactures, mines and quarries, power units, communication, transporta-



tion agencies, trade, and services for the years ending in "2" and "7"; also the plan of making such annual compilations as will preserve the continuity of the data obtained in the quinquennial censuses and minister to the needs of other governmental and private agencies by the more frequent reporting of some of the basic data.

#### THE 1935 CENSUS OF MANUFACTURES

The scope of the biennial censuses of manufactures for 1931 and 1933 was considerably curtailed as compared with that of prior censuses; but the manufactures census for 1935 will be as comprehensive and detailed as that for 1929, which was taken in connection with the Fifteenth Decennial Census. The inquiries of a general character, applying alike to all manufacturing industries, include all those that were in the 1929 census; and one general inquiry—that pertaining to employment—has been amplified to provide for reporting the number and total compensation of technical employees as a separate group (comprising chemists, electrical and mechanical engineers, designers, etc.), and for reporting also the number of clerical employees on the rolls in March, June, September, and December. The wage-earners will be reported for each month, as in prior censuses.

The general inquiries covered by the census of 1929 but omitted in the 1931 and 1933 censuses and now restored, include fuel, power equipment, electric energy, and distribution of sales. The "special" industry schedules—covering 261 of the 310 industries distinguished in the census classification—are similar to the corresponding schedules used in the 1929 Census. In general, the amount of production detail—quantities and values of individual kinds or classes of products—called for is about the same. In some cases, however, the inquiries covering kinds, quantities, and cost of principal materials consumed, and those covering equipment in use, which appeared on certain of the 1929 schedules, are not carried on the corresponding schedules for 1935. These are practically the only respects in which the 1935 schedules have been curtailed as compared with those used for 1929.

The experiment of using an abridged schedule for the small establishments, which was made in the Census of 1929 and to a greater extent in that of 1933, yielded very unsatisfactory results and will not be repeated in the 1935 Census.

The field work for the census of manufactures has been consolidated with that for the census of business. The canvass is being made by the same corps of enumerators working under the same supervision. Schedules have been mailed to all manufacturers whose names appear on the census list, with instructions to fill them out and hold them until called for by canvassers. This is an innovation. Heretofore it has been the practice to request manufacturers to send in their returns by mail, and to depend on canvassers to visit only those manufacturers who failed to do so within a reasonable time.

#### THE 1935 CENSUS OF AGRICULTURE

The plans for the 1935 census of agriculture were described briefly in the December, 1934, issue of the JOURNAL. The canvass was begun on January 2, 1935, and was completed by April 1. By the end of the year the machine

tabulation for the first series of printed state bulletins covering the principal crops and classes of livestock had been completed; and of the 44 bulletins that had been prepared for the printer, 34 had been printed comprising figures for 2,665 of the 3,070 counties in the United States. A second series of state bulletins is being prepared covering farm population, mortgages, chickens and eggs; but it will be several months before this is completed.

In this census a much wider use has been made of the preliminary county press releases than ever before. The Demonstration Service of the Department of Agriculture has a county agricultural planning program based upon the county census figures; and because of this and other important agricultural programs, local papers have published the results quite widely. The county releases are prepared in news form suitable for popular reading. State statisticians and county agents have placed requisitions for large numbers of these summaries.

The final volume of the census containing the first series of state bulletins will be printed before the end of this year.

#### A NEW POLICY AS REGARDS REGISTRATION TESTS

The Bureau of the Census, ever since it was entrusted with the compilation of vital statistics under the permanent census Act of 1902, has endeavored to establish and maintain a standard of 90 per cent completeness in the registration of births and deaths. One by one the states, as determined by such tests as were applied, have reached this standard and been admitted to the registration area. In a few instances a state after being admitted has been dropped for failing to maintain the standard but has later been restored. So at the present time all states are within the area.

The Bureau must continue to make tests to check the completeness of the registration; but the object of such checks hereafter will be to help the state with its problems of registration rather than to threaten its removal from the registration area. The public must be educated to this new point of view. Regardless of whether a state measures above or below the accepted standard of 90 per cent completeness, the data should be compiled and published for scientific investigators; and the users of vital statistics can then correct the data for each state according to the relative completeness of registration as ascertained by satisfactory tests.

In view of this new policy, the need for better methods of determining the completeness of registration becomes one of the most urgent problems confronting the Division of Vital Statistics. Coöperative effort will be required to develop sampling or other methods which will be relatively inexpensive, which can be repeated in each state year after year, and which will be both unbiased and dependable. On the basis of such tests, the states can be compared and the backward states encouraged and aided to build up and perfect their systems of registration.

J. A. H.

## CHAPTER ACTIVITIES

**THE ALBANY CHAPTER.**—Dr. Albert H. Hall, Director of Training and Research for the Mayors Conference, spoke before the Albany Chapter on January 23, 1936. The subject of his discussion was "Statistical Facts about the Municipal Tax Dollar."

**THE BOSTON CHAPTER.**—The eighth annual meeting of the Boston Chapter was held at the Boston Chamber of Commerce on December 16, 1935. The President, Howard C. Baldwin of Babson's Statistical Organization, presided. The subject of the evening's discussion was the Social Security Program, with special reference to Unemployment Compensation in Massachusetts. Judge Emil E. Fuchs, Chairman of the Massachusetts Commission on Unemployment Compensation, outlined the provisions of the unemployment compensation act and indicated a number of difficult problems confronting the Commission. Mr. Robert J. Watt, a member of the Massachusetts Commission on Unemployment Compensation, discussed the social security program from the point of view of labor and answered questions presented by the members.

Professor D. S. Tucker of the Massachusetts Institute of Technology, was elected President of the Chapter. Roswell F. Phelps was reelected Secretary-Treasurer. The Secretary of the American Statistical Association, Frederick F. Stephan, presented briefly new developments in the activities of the Association.

**THE CHICAGO CHAPTER.**—On November 18, 1935, the Chapter had a dinner meeting on "Measuring Market Potentials in the Post-Depression Period." The principal speaker was Mr. L. D. H. Weld, Vice President and Director of Research of McCann-Erickson, Inc.

"Upturn or Pending Breakdown in Europe?" was the subject of a meeting on December 11, 1935, addressed by Dr. Melchior Palyi, Visiting Professor of Economics, University of Chicago. At this meeting the Grain Market Analysts Club and the Investment Analysts Club met with the Chapter.

**THE NEW YORK DISTRICT CHAPTER.**—A dinner meeting of the New York District Chapter was held on November 21, 1935, with a program on the general topic, "New Mechanism of Banking and Credit Control." George E. Roberts, Economic Advisor of the National City Bank of New York, was the presiding officer. J. H. Riddle, Economist of the Bankers Trust Company, discussed "The Trend of Bank Assets and Deposits." "Problems of Banking and Credit Policy" were discussed by Alexander Sächse. Professor Oliver M. W. Sprague of Harvard University spoke on "The Problem of Credit Control." The discussion was led by Frederick Macaulay, of Bernstein-Macaulay, and Willard L. Thorp, Director of Economic Research, Dun & Bradstreet.

**THE PITTSBURGH CHAPTER.**—The October meeting of the Pittsburgh Chapter was addressed by James Steele Gow, Executive Director of the Falk Foundation. Mr. Gow's subject, "Income and Economic Progress," covered the high spots of recently completed economic studies of the Brookings Institution.

On December 5, Theodore A. Veenstra presented the results of a study of "Regional Shifts in the Bituminous Coal Industry with Special Reference to Pennsylvania" undertaken by the Bureau of Business Research of the University of Pittsburgh.

The 1935 Annual Meeting of the American Statistical Association was reviewed by members of the staff of the Bureau of Business Research at a meeting of the Chapter on January 9, 1936. On January 23 the Chapter met with the Pittsburgh Personnel Association to discuss the Social Security Act.

**THE SAN FRANCISCO CHAPTER.**—Dr. E. F. Penrose, Professor of Economics at the University of California, addressed the San Francisco Chapter at a dinner meeting on October 24, 1935. His subject was "Business Depression and Recovery in Japan." He pointed out that after the collapse of the war boom Japan experienced a severe depression from which it has only partially recovered. Rice cultivation occupies a leading place as a source of income to Japanese farmers. The marked growth of production in Japanese colonies of varieties of rice acceptable to Japanese consumers and produced at lower costs than the greater part of the Japanese crop, together with an uneconomically small unit of operation in Japanese agriculture, adversely affected Japanese farmers long before the great world depression began. The raising of silk cocoons and the production of raw silk were also large sources of income to Japanese farmers, but the competition of rayon and mixed fabrics was felt even before the great depression. Progress was being made in cost reduction and it is unlikely that apart from the world depression any catastrophic decline would have taken place. These unfavorable tendencies were offset to some extent by the steadily improving prospects of cotton textile exports. In addition domestic production was replacing imports of woollen textiles and the foundations of the rayon industry were being laid. The potential strength of Japanese industry was underestimated in Western countries.

Financial difficulties have been endemic in Japan and were intensified by the aftermath of war inflation. After the depression of 1921, a substantial divergence between the relative positions of Japanese wholesale prices on the one hand, and American and British wholesale prices on the other, with respect to their pre-war levels, indicated that a considerable, though by no means identical, shift had taken place in the equilibrium rates of foreign exchange. Through most of the post-war decade the yen exchange was supported "artificially." The available evidence seems to indicate that the domestic prices of some productive factors, goods, and services were not adjusted to the pre-war exchange parity which was reestablished when Japan returned to gold in 1930. The resulting difficulties were intensified by the

rapid deflation in other gold standard countries which characterized the world depression. The situation was complicated by the startling fall in the price of silver and the appreciation of the yen with reference to the Shanghai tael. Japanese economic enterprises in Manchuria as well as those in Japan were adversely affected.

Deep depression prevailed in Japan during a large part of 1930, the whole of 1931, and a large part of 1932, throughout agriculture, industry and domestic and foreign trade. At first raw silk was most seriously affected, owing to the great fall in American incomes and the overvaluation of the yen abroad. In 1930 losses in exports were concentrated mainly on raw silk, silk piece goods, and cotton piece goods. In 1931 the further substantial decline was widely diffused. The worst year of the depression in Japan was 1931. In yen values, exports of raw silk and silk piece goods fell to the lowest levels reached since 1917 and 1915 respectively.

In 1932 Japan's foreign trade began to recover and in 1933 the recovery became very rapid. This was correlated with a revival—after a time amounting to a boom—in manufacturing industry. But neither the revival nor the boom extended to agriculture, which remained depressed even in comparison with the far from favorable position it occupied before the world depression began. Notwithstanding the spectacular increase in the activity of manufacturing industry and export trade, there has been no such well-balanced, all-round recovery as in Sweden.

The continued depression in agriculture has been associated with conditions affecting rice and raw silk. In the second half of 1932 and for a few months in 1933 the raw silk outlook appeared to be improving but a new collapse occurred in the late autumn of 1933. The depreciation of the yen contributed to the improvement in 1932 but this advantage was lost in 1933 owing to the depreciation of the dollar. Other factors contributed to the collapse in 1933. American rayon, cotton, and mixed fabrics have encroached on demand for silk in America and the Japanese rayon industry has encroached on domestic demand. Silk will not be completely deposed by other fabrics, but mulberry growers, cocoon raisers and raw silk producers in Japan will have to adapt themselves to a low level of prices and pay their way by keeping costs low, on account of elastic demand due to possibilities of substitution. Improved technique enables more fibre to be derived from a given quantity of cocoons and mulberry growing and cocoon raising are hardly likely again to afford so large a supplementary income to farm families as in the pre-depression period.

The plight of rice growers is due to intensified competition from low cost producers in Japanese colonies and to abnormal fluctuations in yields per acre since 1929, due mainly to natural causes. The two largest crops in history were harvested in 1930 and 1933; the smallest since pre-war times in 1934. The Rice Act, which gives the government power to buy, store, and sell rice, was amended in 1930 and 1933 and buying operations have been carried on in large volume during the depression. Stocks have been large and costs of storage and losses due to deterioration substantial. The levels at

which it was sought to maintain rice prices are above those which would equate supply and demand in a long period. The Rice Act is costly to the taxpayer and fails to deal with the roots of the difficulties faced by rice producers.

The remarkable expansion of manufactures has been associated with increasing exports. A profound change has taken place in the composition of Japanese exports. Exports of raw silk, a semi-manufactured article made from domestic raw materials, have declined greatly in value, while exports of goods made from imported raw materials and in an advanced stage of manufacture, and of goods ready for final consumption, have greatly increased. In 1929 the total value of raw silk exports was nearly double that of exports of cotton goods. By 1934 cotton goods had gained a long lead over silk. The rayon and woolen industries have greatly expanded during the depression and advanced into export markets. These changes appear to be permanent in character, and involve considerable change in the economic structure of Japan. Increased exports have not been confined to textiles other than silk, but embrace a variety of articles the aggregate values of which are important.

The changes in the composition of Japanese exports have conferred substantial benefits on raw material producers in various parts of the world. Imports of raw cotton and wool into Japan have been substantially larger in physical quantities since 1932 than they were in 1929. The same thing is true of iron, rubber, cotton, tin, and mineral oil. Low priced exports from Japan have forced producers abroad to giving increased attention to cost reduction and in part have created an effective demand for certain goods among consumers who formerly, because of low incomes, were forced to dispense with such goods.

Successes of Japan in export markets may be attributed to currency depreciation in some cases, but other more fundamental factors are involved. Technical improvements within the factory and improvements in the organization of industries, an abundant supply of power due to the remarkable development of the electrical industries, the centralization of marketing and raw material purchases in a few large units, and low wages have all played a part. There is undoubtedly much "exploitation" of labor in Japan in the sense that collective bargaining is little developed and is often suppressed when attempted by labor organizations. But the tendency in Western circles to identify low wages exclusively with the results of such exploitation is absurd. By far the most important reason why wages in Japan are low in comparison with wages in America, England, Australasia, and Scandinavia, is the fact that in relation to the supply of other factors of production, the supply of labor is much greater in Japan than in the Western countries in question. Relatively low wages in Japan are therefore inevitable under existing conditions, in any social system.

Up to January, 1932, Japanese financial policy in the depression was dominated by conscious pursuit of deflation. At a time when official spokesmen in America asserted that business was "sound" and urged investment,

official spokesmen in Japan exhorted the people to tighten their belts and prepare for additional sacrifices. In January, 1932, this policy was abandoned and following departure from the gold standard an expansionist policy was embarked on. Budgetary deficits have been met by loans. The volume of securities held by banks has greatly increased. The national debt has practically doubled. Bank deposits have increased considerably, but loans and discounts have actually contracted, especially during the period of recovery. The export industries which have expanded most had a large unused capacity during the depression and even now are not producing to capacity; their financial policy has been more conservative than it was before the depression, with the result that they appear to have been in a position to finance expansion largely without resort to the banks. Moreover some industries have benefitted greatly from Government expenditures in connection with the invasion of Manchuria and North China.

Both wholesale and retail prices have risen considerably since 1932 but are still well below the 1929 level. Money wages have remained fairly stationary since 1932 and are well below the 1929 level. The domestic market has not shown the expansion that might have been expected in view of the recovery in foreign trade. The increased loan expenditure has been an important factor in recovery but much of the expenditure incurred in respect to operations in Manchuria represents foreign investment which cannot in the near future increase the quantity of goods available for consumption in Japan proper. Hence productive activity in Japan has increased faster than consumption. Just as in 1932 Western observers vastly underrated the economic strength of Japan, so in recent times, some of them have tended to view the economic future of Japan with undue optimism.

The following officers were elected for the year 1935-1936: President: Newton M. Sherman, Manager, Division of Analysis and Research, Federal Reserve Bank, San Francisco; Vice-President: M. K. Bennett, Food Research Institute, Stanford University; and Secretary: William A. Sturm, Research Department, California State Chamber of Commerce, San Francisco.

WASHINGTON STATISTICAL SOCIETY.—A dinner meeting was held on November 7, 1935, at the Cosmos Club to discuss the general topic, "How Much Do We Know About Current Industrial Activity and Employment?" Mordecai Ezekiel introduced the three speakers.

The discussion was opened by Mr. Meredith B. Givens. He pointed out the difficulty in the case of production statistics of finding suitable units of physical volume and mentioned the use of related measurements, such as "per cent of capacities," "per cent of full time," "spindle time," "new installation of machinery and equipment," et cetera. Another group of substitute figures related to the consumption of raw materials, such as "cotton consumed," "receipts at markets," et cetera. In the development of composite measures, the movement of the product either in terms of physical units or value units may also be substituted for direct measurement of pro-

duction by securing figures on rate of truck shipments, imports and exports. Data on commodity stocks may likewise be used as a substitute, including measures of "goods in process" and "stocks of finished goods."

In contrast to the statistics of production, employment and pay roll figures involve similar and more homogeneous units. However, there is a wide variability in the quality of the employment data now compiled. There are also important differences in the meaning of the term "employment" as used by the Census Bureau and the Bureau of Labor Statistics. While the evening's discussion was not concerned with wage rates, prices, costs and financial data, it was pointed out that cross section vertical studies of individual industries required the use of statistical data covering each phase of the industrial operation.

The long history of current labor statistics was contrasted with the development of current production data. Whereas labor statistics at one time lagged behind the growth of production data, this relationship has been reversed, especially since the war and today labor data are considerably superior to production data in coverage and in quality. The N.R.A. advanced materially the development of labor statistics, but its effect on production statistics is still rather uncertain, although it is clear that serious difficulties were created by the highly complex classification of industries for code purposes. The Bureau of Labor Statistics has begun the publication of aggregate figures instead of limiting itself to index numbers and has thereby produced a new strain on the reported figures. The Bureau is now making adjustments to census figures previously made by the Federal Reserve Board. It has gone far in improving the coverage of its samples and has increased its coverage of man-hours and non-manufacturing industries. Among the unsolved problems that it faces are the problem of including new firms in current reports, the desirability of securing tabulation by sex to make unnecessary special studies of the employment of women, the classification problem, particularly that of industrial classification, the extension of man-hours reporting, and the problems of Federal-State coöperation which have been rendered more complex by the development of unemployment insurance.

For production statistics, there are two major problems. A clear definition of what is wanted would help greatly in developing these series. Extremely important is the need for the designation of a focal or key agency to assume responsibility for developing current production statistics with adequate equipment and resources to discharge that responsibility. The lack of such an agency has been largely responsible for the unsatisfactory development of this field. This agency should establish contacts with trade groups and pull into the Federal storehouse the statistics which are needed, returning to these groups results which will justify their coöperation.

The next speaker was Mr. Isador Lubin, Commissioner of Labor Statistics, who continued the discussion of current employment statistics. He began by referring to the recent newspaper comparisons of production and employment statistics in which it had been concluded that the United States



would return to the 1929 level of production with considerably less than the 1929 level of employment. He pointed out that the two series were not comparable, first, because they do not cover identical industries, and second, because the employment figures represented the number of workers on pay rolls regardless of the number of hours that they worked. The production indexes are on a different basis and should be compared with man-hours rather than employment.

The Bureau of Labor Statistics covers in its indexes of employment 90 industries, including 85 per cent of the nation's factory workers, and 17 non-manufacturing industries. In the former group there are 74 industries for which the coverage is more than 50 per cent of all persons employed in the industries. In all but six of them the percentage is at least 60 per cent. Only the turpentine industry has less than 30 per cent coverage. This industry has been retained because it represents more than 10 per cent of all factory workers in Florida and Georgia, and an attempt is being made to increase the coverage in preference to dropping the series. These samples are quite representative of the number of persons employed in the industry, but they are biased toward large industries. It is felt that when there are a few large firms that all the firms should be covered. A shut-down, a strike, a fire or other serious disturbances of employment in a single large firm may affect an important fraction of the employment in the industry. It is difficult to secure extensive coverage in industries composed of a large number of very small plants, often with frequent changes of name, location and ownership. Some of these industries, however, were very helpful under the N.R.A. For example, the Bureau received copies of pay rolls from the men's clothing industry for eighteen months.

The immense size of the retail industry, with 1,500,000 establishments, makes it virtually impossible to secure representative coverage. The Bureau is making an attempt to divide the industry into a number of groups or lines tying each in with the manufacturing group with which it is most closely related. The coverage of dyeing and cleaning is being expanded. Banking employment is so stable that semi-annual reports have been regarded as adequate and it is planned to secure them in coöperation with the Treasury and the Federal Reserve Board in connection with their regular reports. In building construction, reports are being received from approximately 10,000 contractors in more than 50 cities, covering some 80,000 workers in private construction. During the last six months, with the coöperation of the Central Statistical Board, the Bureau canvassed 86,000 contractors and more than 20,000 reports have been received, but these have not yet been added to the construction index since it is not known how regularly the reporting will be continued. For all construction financed in part or in whole by federal funds almost complete coverage is achieved, because a clause requiring reporting is written into the contract. At the present time, the Bureau is testing the relative value of construction employment reports based on a one-week basis as compared with a four-week basis.

Comparison of the employment figures with the census data for 1933

showed some biases upward or downward. Many of these discrepancies were found to be due to bad classification of firms in the index. Some were due to the inadequacy of the sample. As a result of social security legislation, it will become possible to secure current employment statistics as a by-product of the collection of funds. The Bureau is now negotiating with one of the states to secure data in this way for the firms that are covered in the Bureau's indexes. The prospect, therefore, is one of decreasing emphasis on the collection of statistics and increasing emphasis on their analysis.

Mr. Woodlief Thomas of the Board of Governors of the Federal Reserve System sketched the development of production statistics from the early activities of the War Industries Board, the Federal Reserve Board, and later the Department of Commerce under Hoover. Early in the development appeared the annual production indexes prepared by the War Industries Board, Walter W. Stewart, E. E. Day, and W. M. Persons, and later the Harvard Economic Service monthly index and the various monthly indexes compiled by the Federal Reserve Board. The current Federal Reserve index has come to be accepted as the standard. There are also a comprehensive biennial index based on the Census of Manufactures and some specially compiled monthly and annual indexes.

One of the uses of the Federal Reserve indexes is to measure the total volume of production; for this purpose the index of manufactures agrees remarkably well with the biennial Census index and the combined index of manufactures and minerals agrees with a special annual index of output of all goods and related services prepared by Simon Kuznets in connection with his study of capital formation. The Federal Reserve index directly represents industries which account for about 40 per cent of the total manufacturing production of the United States and 72 per cent of mineral output. The Census index directly represents about 48 per cent and indirectly represents some 90 per cent of all manufactures. The number of series included in the Federal Reserve index has diminished, however, since it was started. There are also important questions of its representativeness on a monthly basis. For example, ingots produced in one month may represent machines produced several months later. A full test of representativeness is difficult, but some interesting differences appear when the index is compared with indexes of employment based (1) upon a comparable group of industries and (2) upon industries not directly represented in the production index.

A second use of the index is to analyze current changes in production by industries. A break-down of the index by major industrial groups shows differences in their behavior at different points in the depression. Production data may be used in connection with data on sales, stocks, and prices in testing the working of the price system. For these purposes accuracy is especially important.

The Federal Reserve monthly index is now undergoing revision, but there are serious deficiencies in available data. Important questions of weighting and adjustment also arise in the preparation of the index.

With regard to available production data, when the Census index was

first compiled, there was a lack of satisfactory data available even on a biennial basis for such important industries as bread and bakery products confectionery and ice cream, women's clothing, machinery and electrical equipment, furniture, printing and publishing, and pottery. In recent censuses physical data for certain of these industries have become available. Biennial data have been available for some time for canning and preserving, paper boxes, paints, manufactured gas, and bricks, but there have been no adequate monthly figures for these industries. Important available monthly information not in the Federal Reserve index include dairy products, rayon, and glass containers. In a number of industries the monthly statistics are not entirely satisfactory. For example, for textile products they are based upon the consumption of raw materials; for paper, tires, and copper the series lack continuity; and for lumber the coverage is small in some regions and changing. Production statistics are especially weak in building materials, chemicals, machinery, and most finished goods. These deficiencies are particularly serious because they occur in industries which show new and rapid developments.

The principal causes of the unsatisfactory character of production statistics are (1) the difficulty of representing and measuring physical production, (2) the haphazard method of collection, which is not based on public need, but rather on the willingness of firms to report, (3) the failure to keep up series after they have been started, (4) the lack of an adequate budget and a principal agency to develop the statistics, and finally (5) the need for a closer relation between use and analysis of production statistics and their collection.

On December 19, 1935, a group meeting was held for the technical discussion of sampling procedures. The discussion was opened by three brief statements—Alexander Sturges, Bureau of Agricultural Economics: "The New York Foods Consumption Survey;" Sidney Wilcox, Bureau of Labor Statistics: "A Weighting Method to Correct for Overexposure of Multi-earner Families;" and Charles Newcomb, Works Progress Administration: "Sampling Procedure in the 1935 Michigan Population and Unemployment Census."

## STATISTICAL NEWS AND NOTES

**BUREAU OF STATISTICS, INTERSTATE COMMERCE COMMISSION.**—The forms used for reporting railway operating statistics to the Interstate Commerce Commission have been given a general revision effective January 1, 1936. The principal changes of statistical interest are the following: Items obtainable from the wheel reports such as ton-miles and car-miles are segregated and are to be reported about one week earlier than heretofore. The separate heading "mixed trains" is abolished, such trains being assigned to the freight or passenger service according to their predominant nature. Gross ton-miles are subdivided according to the nature of the power—coal burning, oil burning, or electric. Suburban train statistics are more completely separated from regular passenger service. The item "train hours" is to be shown for passenger trains as well as for freight. Certain yard service statistics heretofore reported only annually will be shown monthly. Fuel statistics are slightly amplified by adding a separate item for Diesel fuel, gasoline, and electricity in road freight service.

The Interstate Commerce Commission has also adopted a revision of the rules for the separation of operating expenses between freight and passenger services. This is the foundation for all computations purporting to show the cost of performing particular freight or passenger services. The changes made will not affect materially the general results obtained heretofore, but it may be of interest to note that the separation between services has been extended to include operating rentals and taxes. The basis for separating the running track expenses has been changed from cost of fuel consumed by each class of trains to the gross ton-miles of the trains, including the locomotive ton-miles.

The Interstate Commerce Commission also modified its policy with respect to the filing of annual reports. For many years it required a separate report for each active corporation owning or operating a railway in interstate commerce. Recently certain groups of corporations constituting systems have been permitted to file consolidated reports and it is expected that for 1936 such reports will be required where appropriate. This will make the reports more serviceable to students of railway finance.

**FEDERAL TRADE COMMISSION.**—In its closing days, the last Congress passed the Wheeler Resolution directing the Commission to conduct an inquiry into agricultural income, etc., and to present a preliminary report on January 1, 1936, and a final report by July 1, 1936. The appropriation for the conduct of this inquiry was contained in the Third Deficiency Bill which failed to pass. After some delay, authority was secured from the Budget Bureau by the Commission to use its regular funds for this inquiry and the Commission began its preparation of schedules in accordance with the terms of the Resolution. (Public Resolution No. 61.) On account of pressure to complete the final report on the Power and Gas Inquiry by January 1,

however, only a small staff of about a dozen people were available for this work. The progress made was, in consequence, slow. By the close of the year, however, it was possible to get out schedules to the primary manufacturers of principal agricultural products. The commodities selected for this study were those yielding the farmer a cash income in excess of \$200,000,000 in the year 1934. These products were wheat, cattle and calves, hogs, tobacco, cotton, and milk. The schedules in question, in accordance with the terms of the Resolution, called for the investments, profits, and rates of return of the principal manufacturers of these principal farm products from 1928 through 1934; the salaries of the officers and directors of such companies; the growth of their capitalization and assets; percentage of control of the crop and of the manufacturing of such products obtained and maintained by such manufacturers; and detailed data on purchases, sales, etc., designed to be used to answer the inquiry contained in the Resolution as to the proportion of the consumer's dollar obtained by the producers, manufacturers, processors, and distributors of principal farm products. The figures of gross and net income of these companies which are called for, are required for comparison of the changes in the gross and net income of producers of these principal products during recent years.

The Commission sent to Congress early in the present year its Final Report on the Power and Gas Utility Inquiry covering the Natural Gas Industry.

The second Milk Report dealing with the Philadelphia and Connecticut milk sheds was also sent to Congress early in January. This report deals very largely with the operation of the Base Surplus Plan in Connecticut and Philadelphia milk sheds and the differences in the payments to farmers under the two plans. It also contains a detailed analysis of spreads on milk of different classes and the rates of net profit made on various kinds of milk products distributed by the different companies. A chapter is also devoted to the different methods used in the allocation of delivery costs which permit the showing of low or high costs on particular items depending upon how such costs are or have been allocated. Work on distribution costs and other problems of the Milk industry will be resumed in various other sheds early in January.

At the end of the year, the Commission had not finally completed its tabulation of investment, costs, and profits of the textile companies for the first half of the year 1935. Owing to the failure of the funds for this work to pass until towards the close of the last session, it was impossible to get out the textile schedules for the first half year until many weeks after July 1. The new textile schedules covering the last six months of 1935 are expected to go out early in January and it is anticipated that it will be possible to present the reports for the last six months much more promptly than those for the first six months of the year. A limited number of reports covering detailed costs, profits, etc., for the major divisions of the textile industry for the years 1933 and 1934 are available at the Commission's offices.

**BUREAU OF FOREIGN AND DOMESTIC COMMERCE.**—Annual reports from the offices of Commercial Attachés have been received by the Division of Regional Information. These reports are made so immediately after the close of the year that they do not contain much statistical information. They are in the nature of general economic surveys. While not published by the Bureau for distribution, interested individuals may ordinarily consult copies at District Offices or borrow them from the Division mentioned above.

The Finance Division plans to have its preliminary statement on the "Balance of International Payments of the United States," calendar year 1935, available this month. This Division is also working on a "Handbook on Foreign Currency," which will be completed soon.

The Foreign Trade Statistics Division has published figures on trade with some of the countries with which reciprocal trade agreements were concluded. Their "Summary of United States Trade with World, 1935," calendar year 1935, will be available in a few weeks. Because the value of export statistics is nullified, if the export declarations are not completely, accurately, and promptly made out, mimeographed instructions for exporters and their shipping brokers have been made available for automotive, rubber, and forest products exporters. The pamphlets explain in detail their respective sections of Schedule B, export classification, which is the official United States Government classification of exports. The new revised edition of Schedule B was released in December. Trade Promotion Series, Number 72, "The Shipment of Samples and Advertising Matter Abroad," was brought up-to-date by a revising circular which was released in December. "Advertising in the Union of South Africa" and "Preparing Shipments to Europe," will be available at the time this note is published or a few weeks later.

A 1936 edition of "Sources of Current Trade Statistics" is being prepared. Progress on this source book will be reported in the June JOURNAL. A survey of "Markets for Electric and Gas Facilities in Residential Urban Homes" will be available in a few weeks. Information for this survey has been taken from the data on 64 cities covered in the Real Property Inventory. Studies on the location of certain basic industrial markets have been projected. Such a study for textiles is nearing completion. "The Business Information Service" of the Bureau has been revised and is available to the libraries of accepted Universities and Schools of Business Administration. Among recent monographs presented in this service is one on "How Business Men Have Used the Census of Distribution" and a bibliography on "Coöperative Consumer Societies."

A survey of "The Construction Industry and Its Leading Trade Associations" has been prepared. Total annual dollar volume is shown for the years 1925 to 1935 inclusive. The number of firms, the number of employees and the cost of materials is shown and some 40 government agencies having information of special assistance to the industry are briefly described. About 600 trade associations are listed and a reference list of magazines and textbooks dealing with the industry is appended.

**DIVISION OF ECONOMICS AND STATISTICS, FEDERAL HOUSING ADMINISTRATION.**—Some of the activities of the Division of Economics and Statistics which were not reported in the last publication of the JOURNAL are summarized in the following paragraphs.

The Division is engaged in developing a technique for analyzing large-scale housing projects with respect to their mortgage risk. The procedure is designed to be of aid to the Administration in connection with the insurance of mortgages on such projects. It will also be useful to any institution which advances money on this type of security.

The technique provides for an estimate of the general economic soundness of the project without reference to a scheme of financing by balancing productivity against the cost of production, thus making it possible to arrive at a justified cost on the basis of predicted earning capacity. The soundness of the proposed financial plan will be measured by anticipating the total income arising from operations and testing its adequacy in meeting the periodic requirements of expenses and debt service during the term of the loan. Mathematical formulae have been evolved for testing the project under various revenue predictions, as well as under variations of any of the remaining basic elements.

A uniform system of accounts has been prepared for use on all large-scale projects whose mortgages have been insured by the FHA. Forms for a required annual report, and a manual of instructions for their use, have been drawn up for distribution to the managements as soon as operations begin. One project is using this system at the present time.

A complete set of schedules, designed to record the operating experience of multi-family dwellings in a manner comparable to the "Uniform System of Accounts for Low-Cost Housing Projects," has been developed in order to determine trends in expenses and incomes of apartment house projects. A survey of five hundred buildings in nine cities is being undertaken, and data will be obtained for as many years in the past as possible.

A study entitled "Recovery in Construction Activity as Reflected in the Construction Material and Equipment Industries" is in process of publication. It analyzes and appraises available statistics on the volume of construction, the production and shipment of materials, and the status of employment in the construction and material producing industries.

A recently released bulletin entitled "The Report of Bank Loans on Urban Real Estate" presents data on the amount of loans on urban real estate which are held by all commercial banks, and the amount of these loans which conform to the basic requirements for eligibility under Title II of the National Housing Act. The data are presented for National Banks, state member banks of the Federal Reserve System, and other members of the Federal Deposit Insurance Corporation, and by states and Federal Reserve districts.

In order to determine trends in price of residential structures and depreciation or appreciation in their value, the relationship between the original cost and present value of one family dwellings by year acquired is being analyzed

for certain selected cities included in the Financial Survey of Urban Housing. It is planned to extend this technique to all properties on which FHA insured mortgages are issued.

The relationship between rent and income, and the effect of changes in income levels on the rental market, is being studied from data reported in the Financial Survey of Urban Housing and from similar surveys available for West Virginia cities. Preliminary analyses indicate that rents follow very closely Engle's linear expenditure law.

Efforts are being made to determine the size of the sample required to obtain reasonably accurate estimates of the rent and occupancy changes in urban areas. The study is based on a 10 per cent controlled sample survey of occupancy, tenure and rent made in five cities by the Works Progress Administration and the Central Statistical Board in June and July of 1935.

In order to determine losses to be anticipated in long-term amortized mortgages, a technique has been developed for conducting surveys of the mortgage lending experience of financial institutions. Data on 6,697 mortgage loans have been collected from representative financial institutions in four cities and are in the process of being analyzed. The study will be completed shortly.

U. S. BUREAU OF MINES.—In coöperation with the Bureau of the Census, through the Census of Business, the Bureau of Mines will conduct its annual canvass of mineral producers for 1935, employing typical census questions on employment and wages. The questionnaires for individual industries were drafted by the Bureau of Mines and the Bureau of the Census and were reviewed by the Bureau of Labor Statistics and the Central Statistical Board.

Arrangements for use of the regular personnel of the Bureau of Mines in conducting extensive field work have been completed and it is expected that the data on employment and man hours at all mining operations will represent practically complete coverage. Also, complete figures on employment in the crude petroleum and natural gas industry will be collected for the first time since 1919.

BUREAU OF LABOR STATISTICS, U. S. DEPARTMENT OF LABOR.—Work has been started by the Bureau on a survey of prison industries. This survey, undertaken at the request of the Federal Prison Industries, Inc., will show the amount of production in State prisons, the value of goods purchased by various State institutions, and detailed information concerning the work, health, etc., of prisoners.

In coöperation with the National Resources Committee and the Bureau of Home Economics, the Bureau is conducting a nation-wide survey of consumer purchases.<sup>1</sup> This will supplement the study of purchases of the families of wage-earners and lower-salaried clerical workers which was started last year. The new study will cover wider economic groups and communities of

<sup>1</sup> See p. 135.



different size than those covered by the study of wage-earners and clerical workers.

A complete analysis of building permits issued in representative cities for the years 1929 to 1935 inclusive is being made. This study will show, by economic areas within the cities, the number and cost of dwelling houses by cost groups, the number of rooms in dwelling units, and the cubic content of buildings of various types.

The results of the study of administration of workmen's compensation, which has been carried on over a period of several months, are being published in a series of articles in the *Monthly Labor Review*. One article, dealing with the Ontario procedure in the settlement of workmen's compensation claims, appeared in the January 1936 issue, and the second article, on co-operation of workmen's compensation administrations with rehabilitation agencies, was published in the February 1936 issue.

A summary of the results of the survey of wage executions for debt, made jointly by the Bureau of Labor Statistics and the Russell Sage Foundation, also has appeared in recent issues of the *Monthly Labor Review*.

In coöperation with the Works Progress Administration a comprehensive study of reemployment opportunities and recent changes in industrial techniques has been initiated. The study will seek to develop the results of changed methods of production upon labor productivity and labor employment in certain of the major industries of the country.

Industrial wage studies not previously noted are now under way in the water transportation industry, in the manufacture of paper products (set up and folding paper boxes), and in independent tobacco stemmeries.

**UNITED STATES EMPLOYMENT SERVICE.**—*Development of Occupational Classification System:* Recent issues of the JOURNAL have contained descriptions of the Inventory of Registered Job Seekers now being established, and of the Occupational Research Program which the Employment Service is conducting. The Inventory of Registered Job Seekers will provide a mechanism for securing periodic detailed analyses of all job seekers registered with the Employment Service as actively in search of employment. Records cover relief employables as well as persons not on relief rolls. Not all registrants actively seeking employment are unemployed as a small proportion of the registrants are employed persons seeking better positions.

The Occupational Research Program has as its objectives:

1. The preparation of occupational descriptions for use by offices of the United States Employment Service to facilitate classification and selection.
2. The investigation and determination of the characteristics of successful workers in various occupations to prepare evaluation, refinement, and development of practical devices for aiding in the selection of qualified candidates for referrals to job openings.

As one objective of the program it is hoped to develop an employment

office technique which will make possible the placement of workers from depressed industries in those of more promise with a minimum loss of experience and training. Through the analysis of jobs and worker skills it may be discovered that apparently unrelated occupations in perhaps widely separated industries require the same general skills and abilities. Thus, it may become possible to place workers in new jobs which have little surface similarity to previous occupations, but to which previously acquired skills and abilities may be advantageously applicable.

Work on the preparation of occupational descriptions has been carried on in several leading industries. Results of these studies are presented in the form of job specifications which give a concise and accurate picture of the various elements of the job as observed by trained analysts working from 12 offices located in urban centers throughout the country. In final form each occupational description contains identifying material in the form of job titles, the industry and department in which the particular job is found, a detailed description of the tasks usually involved in the job, description and explanation of machines, tools and materials used by the worker, the employment qualifications of the worker usually required by employers, a general description of the working conditions on the job, the relation of the job covered to other jobs in the same industry and special information of assistance in selecting properly qualified applicants. Publication is undertaken on an industrial basis, one or more volumes being issued for each separate industry covered. Volumes have been prepared covering the cotton, textile, laundry, automobile and automobile body manufacturing, and construction industries. The study of the construction industry includes five volumes. Job descriptions for hotels, restaurants, retail selling, lumber and mills, and the foundry and machine shop industries are now in process of preparation.

Of direct interest to statisticians is the system of occupational classification developed in connection with the statistical reporting system of the Employment Service. This occupational grouping was prepared after an analysis of existing occupational systems used in governmental agencies and organized labor and industrial groups.

The chief purpose of the new classification is to describe the occupational character of the unemployed registered with the offices of the United States Employment Service. The system, however, is broadly inclusive and is believed to be adaptable to use in other fields.

Briefly, the classification system consists of eight major groups each made up of a series of jobs which seem to have occupational homogeneity. The grouping of occupations is designed to eliminate industrial stratification as far as possible so as to serve as a basis for indicating the degree of mobility of certain occupations across industrial lines. The sub-groups in each main occupational group represent further breakdowns characterizing the occupations within the group.

A five digit numerical code is used in connection with this classification system, the first digit indicating the major group and the second digit the sub-group in which any particular occupation is a part.

Approximately 9,000 individual job titles are included in the classification system. In the case of alternate job titles referring to a single occupation only one classification is adopted, other titles referring to the same job being indicated by a cross index.

A list of the eight major groups and their sub-groups follows:

#### OCCUPATIONAL GROUPS

- I. Professional and Kindred Workers
  1. Professional Workers
  2. Semi-professional Workers
  3. Technicians
  4. Administrators and Supervisory Workers
- II. Salespersons
  1. Inside
  2. Outside
  3. Related Service
- III. Clerical Workers
  1. Machine
  2. Non-machine
- IV. Service Workers
  1. Domestic
  2. Personal (Outside and institutional)
  3. Maintenance
- V. Craftsmen and Skilled Workers
- VI. Production Workers (semi-skilled)
  1. Predominantly Machine
  2. Predominantly Manual
- VII. Physical Labor Workers (unskilled)
  1. Heavy
  2. Light
- VIII. Unassigned Persons

**BUREAU OF AGRICULTURAL ECONOMICS.**—The Bureau of Agricultural Economics is serving as joint sponsor with the Works Progress Administration in conducting a nation-wide statistical project utilizing "white collar" relief workers. The project contemplates the gathering, from the official records in 1,000 agricultural counties, of data pertaining to farm mortgages filed and released and farm mortgage foreclosures, covering the period 1917-1935. A sample record of farm taxes levied will be obtained for the period 1890-1913. In a smaller number of counties, data will be obtained on farm real-estate transfers to supplement and expand data obtained under a C.W.A. project in 1934.

In carrying out the technical supervision of this project the Bureau will have the active coöperation of most of the State agricultural experiment stations who are designating members of their staffs to aid in setting up and supervising the projects within their respective States. Headquarters for the project will be established at Chicago where the tabulation of the field data will be conducted.

A summary of the food situation and the supply of foods available for domestic consumption during 1935-36, with comparative data for 1933-34, 1934-35 and the 1925-29 average, was released on October 31, 1935.

**FARM CREDIT ADMINISTRATION.**—The Division of Finance and Research in the Washington office of the Farm Credit Administration, headed by Dr. F. F. Hill of Ithaca, New York, includes a financial analysis and statistical section and an economics subdivision which has general supervision over the work of a statistical unit in each of the twelve Farm Credit Administration district offices. The financial analysis and statistical section, under the direction of Mr. D. C. Carnes, is responsible for the collection, compilation, review and analysis of the primary statistical data regularly reported by the institutions under the jurisdiction of the Farm Credit Administration, covering their operations and financial condition. These data include periodic information on applications received, loans closed and outstanding, collections and delinquencies, foreclosures and real estate operations, income and expense items, investment portfolios, securities issued and outstanding, and balance sheet items, for institutions extending both long-term and short-term credit to farmers and farmers' organizations. Together these data constitute a current record of developments in an important sector of the farm credit field.

A program of research studies having a direct bearing upon the formulation of lending policies and the solution of operating problems of the Farm Credit Administration is now being initiated by the economics subdivision of the Division of Finance and Research under the direction of Dr. W. G. Murray, who is on leave of absence from Iowa State College. Projects now being carried on include special studies of credit problems in selected areas, various studies based wholly or largely upon the statistical data collected through the operating units of the organization, an analytical appraisal of the principal foreign farm mortgage credit systems, a study of new recordings of farm mortgages as shown by county records, and periodic current analyses of factors in the general business and agricultural situation having particular bearing upon the operations of the Farm Credit Administration. The development of the entire research program is directed toward improvement of the lending policies, institutional set-up, and operations of the organization and toward critical appraisal of the relationship of the Government to the system.

In addition to the research program being developed in the Division of Finance and Research, the research, service and educational section of the Coöperative Division of the Farm Credit Administration conducts research studies dealing primarily with the organization, operation and financial policies and problems of farmers' coöperative marketing and purchasing associations. Typical studies now being made by the section include an analysis of the financial organization and membership problems of Iowa Coöperative Creameries, an analysis of the merchandising policies of the California Walnut Growers' Association, and an analysis of the coöperative cotton ginning industry in Oklahoma and Texas. All studies are pointed directly to the solution of current practical problems of coöperative associations, such as management, operating methods, financing and merchandising practices, sales policies, costs, transportation, membership relations and

contacts, competitive factors and possibilities for coöperative organization in specific commodities or areas.

**BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM.**—The Division of Research and Statistics of the Board of Governors of the Federal Reserve System, with the assistance of the Federal Reserve banks, is undertaking the supervision of a Works Progress Administration Project on the distribution and activity of the deposits of a number of banks in the period 1928–1933. These banks, now in receivership, number about 140. The main purposes of the study are to supplement existing information on the variations in the deposit balances of different economic classes in different phases of business activity, to analyze the type and character of drains which these banks experienced prior to suspension, to throw some light on the relation of deposit balances to credits to personal deposit holders' accounts, and to provide information on the relation of borrowers' deposits to their borrowings.

**U. S. PUBLIC HEALTH SERVICE.**—The health inventory which was described in this JOURNAL (December, 1935, p. 746) is now being carried on in every one of the 95 cities, employing a total of 3,517 persons, 3,194 of which are from the relief rolls. The survey is being conducted from a field central office in Detroit, Michigan, where the coding and punching of the data will also be done. The health survey is under the direction of Assistant Surgeon General L. R. Thompson, in charge of the Scientific Research Division, with G. St. J. Perrott acting as project director and Clark Tibbitts as field director with headquarters in Detroit.

With reference to the permanent activities of the Public Health Service, Dr. William Gafafer of the Johns Hopkins School of Hygiene and Public Health has recently been appointed Senior Statistician to be in charge of the statistical work of the Office of Child Hygiene.

**DIVISION OF VITAL STATISTICS, BUREAU OF THE CENSUS.**—The Division of Vital Statistics, Bureau of the Census, issues two annual volumes—*Mortality Statistics* and *Birth, Stillbirth and Infant Mortality Statistics*. In addition to these annual volumes, it has been the practice to prepare a number of special studies upon subjects in which public interest was manifest. These studies have been released to interested individuals.

It is the desire of the Division to amplify the variety and number of such studies in the future and to make them available to the public. To achieve this end, the Division is inaugurating a new series, which will be entitled *Vital Statistics—Special Reports*. Each report will be identified in the series. The page numbering will be consecutive throughout the year. At the end of the year a table of contents and cross-index will be prepared as a part of the series so that the special reports may be bound and preserved.

Very few of the reports in this series will be provisional or preliminary in character. They will provide the latest available data on mortality, natality, and stillbirths. They will include information and studies upon

topics in demand by the public, the press, the state and city health officers, the registrars, as well as scientific statistical groups. Although some of the *Special Reports* will appear later in the regular annual volumes, in most instances the data and the analyses will be published only in this series. The scope of the reports will cover trend analyses over a period of years, intercomparisons between states and cities, special data on important or unusual causes of death, on multiple causes of death, or on births, new tabulations on residence, and a variety of analytical studies and discussions of important problems in the field of vital statistics.

In order to ensure the widespread availability of *Vital Statistics—Special Reports*, the new series will be mailed to a list of depository libraries which have agreed to preserve them. They will be sent to the office of each registrar of vital statistics in states and large cities where it is hoped they will be filed and preserved for reference. They will be sent to a small select list of foundations, schools, and statistical agencies particularly interested in using vital statistical data and will be made available to the public press.

The Division of Vital Statistics is publishing a new paper entitled *The Registrar*. It was released for the first time on January 15, 1936, and will be issued periodically thereafter on the fifteenth of each month. The publication of this paper is intended to fill the need for a dependable method of communication between the registrars of the country. Each state and city registrar should know the problems which face the registrars of other states and cities. He should receive current news of happenings in Washington, which might concern his interests. It is expected that he will contribute items of interest, news, problems, and statistics from his locality. It is hoped that the paper will become a useful link in correlating registration activities in Vital Statistics.

**WOMEN'S BUREAU, U. S. DEPARTMENT OF LABOR.**—Recently completed by the Women's Bureau is a study made at the request of the Commissioner of Labor of Texas of the hours, wages, and working conditions of women in Texas industries. A total of 369 establishments in 43 cities and towns were covered, including factories, stores, laundries, hotels and restaurants, and telephone exchanges. Important data also were obtained on industrial home work; the type of work covered was the making of infants' and children's garments, and handkerchiefs, and the shelling of pecans. Wage data for 15,343 women were copied from pay roll records for a week as near the middle of February 1932, as possible, and whenever they were available similar records for a week in 1931. Records of time worked during the week whether reported in hours or days were obtained where possible. Results of the investigation of working conditions in the establishments visited and information concerning the workers as to age, nativity, marital status, and length of service with the firm also are presented in the survey. Manufacturing plants made up 37 per cent of the establishments visited and employed over half of the workers for whom wage data were obtained. Statistical data were tabulated by racial groups—2 of every 11 women included in the survey were Mexicans, and about 1 in every 11, Negroes.

On the whole, the study shows long hours and low wages prevailing in the State. While 85 per cent of women telephone operators had a weekly schedule of 48 hours, a scheduled week of more than 50 hours was reported for over half the women in factories, stores, and laundries, about 30 per cent of the total having a week of at least 54 hours. Of all women, 20.9 per cent earned less than \$5 a week and 67.5 per cent earned less than \$10. Only 10.6 per cent earned as much as \$15 for their week's work, and 28.2 per cent of these were telephone operators. In practically all cases the proportions earning \$15 or more a week were much larger in 1931 than in 1932.

A summary of employment standards which will insure the health and safety of women in industry has just been published by the Women's Bureau. "To formulate standards and policies which shall promote the welfare of wage-earning women, improve their working conditions, increase their efficiency, and advance their opportunities for profitable employment," are the duties of the Women's Bureau as outlined in the Act of Congress creating it. Through its 18 years of existence, the Bureau has attempted to establish adequate employment standards on the basis of scientific investigation. The present summary brings together its findings and constitutes a valuable handbook to employer or employee. Among the standards discussed are those for wages; hours; working conditions, such as lighting, ventilation, cleanliness, noise, vibration, seating, and fire protection; the provision of personal service facilities such as drinking, washing, and toilet facilities and dressing, rest, and lunch rooms; and industrial accidents and disease.

OHIO COLLEGE ASSOCIATION.—The Committee on Entrance of the Ohio College Association has prepared a four-page uniform college information blank to be filled out by senior students in Ohio high schools. This form has been filled out by 40,000 senior students. From the resulting punched Hollerith cards it will be possible to give each Ohio college separate packs of duplicated cards (with the data typewritten as well as punched on the card) for all pupils specifying the college as first, second or third choice. Mimeographed lists will be available showing (1) pupils of promise needing scholarships and (2) pupils of promise who are undecided as to college attendance, with additional information about those pupils who meet the college's specifications as to the "ideal type" of student. It will also be possible to study intensively the problem of educational opportunity in Ohio as dependent upon such factors as race, sex, father's occupation and intelligence.

OFFICE OF EDUCATION.—Tabulations have been completed for "Statistics of State school systems, 1933-34," and copies of all the tables are on file in this office. The same is true of "Statistics of city school systems, 1933-34," except that copies are kept for the first five summary tables only. These studies have gone to the Government Printing Office. "Per capita costs in city school systems, 1934-35," is completed. Photostat copies of the tables are available for loan while the study is being printed. Tabulations are progressing on "Statistics of public high schools, 1933-34," and "Statistics

of higher education, 1933-34." Total figures are not yet available. A study is in progress for certain general and financial items for a sampling of rural county school systems compared with urban, city, school systems and rural-urban county unit school systems.

**DIVISION OF RESEARCH, STATISTICS, AND RECORDS, WORKS PROGRESS ADMINISTRATION.**—On November 22, 1935, a new division of Research, Statistics, and Records was authorized by Mr. Gill under the direction of Emerson Ross. This includes the old Division of Reports, Statistics, and Records and the Division of Research and Planning of the Works Progress Administration and such Federal Emergency Relief Administration statistical and economic activities as may be continued. On the same date Howard B. Myers was authorized to continue the activities previously carried on under his direction under the new title of the Division of Social Research of the Works Progress Administration.

Although the Federal Emergency Relief Administration has ceased to grant funds to the States for relief purposes, the Division of Research, Statistics and Records is planning to continue to obtain basic statistical information concerning the number of persons and cases receiving general relief financed with public funds and amounts of obligations incurred, by sources of funds.

Various studies are being undertaken in an effort to preserve statistical and descriptive summaries of the numerous activities and programs of the Federal Emergency Relief Administration now being discontinued. Several have appeared in recent issues of the *Monthly Report of the Federal Emergency Relief Administration* while others are in preparation for subsequent issues.

One group of such summaries covers the financing of emergency relief. An analysis of State financing of relief followed by a survey of State borrowing for relief purposes has appeared (July and August Monthly Reports). A review of State relief financing through the sales tax is completed, while other phases of State relief financing are in process of summarization for publication.

A statistical and descriptive summary of the production-for-use activities of the Emergency Work Relief Program has been published. Likewise, another article summarizes the activities of the former Federal Surplus Relief Corporation, an organization created to make available to persons on relief some of the surplus agricultural commodities. A survey of the operations of the rural rehabilitation program prior to its recent transfer to the Resettlement Administration has also been completed. The results of an analysis of the relationship between estimates of unemployment and the relief data will appear shortly. A final summary of the Civil Works Program is being undertaken and an intensive analysis of work relief has just recently been initiated.

**DIVISION OF SOCIAL RESEARCH, WORKS PROGRESS ADMINISTRATION.**—Materials of the March Labor Inventory are being prepared for publication as



a "Census of Usual Occupations of Workers on Relief, March 1935." The tables classifying workers on relief by age, type of usual occupation, place of residence, color and sex, have been completed for the United States and for each State and will be included in the census volume. A second complete count, giving usual occupations and employment status of relief workers certified as eligible for Works Program employment, is being taken on January 15, 1935; data will be made available for the United States, each State, and the Districts of the W.P.A.; county information will also be on file. Plans are completed for a special sample study of the educational attainments of workers on relief in March 1935, to supplement the census volume referred to above. Data will be prepared to show educational attainment by occupation, and by age, for urban, rural, color and sex classifications of workers.

With the withdrawal of the Federal Government from relief activities, the thirteen city *Study of Current Changes in the Urban Relief Population* is to be discontinued. It will be replaced by a *Study of Trends in the Economic Status of Former Urban Relief Cases* (to be conducted in the same thirteen cities) which will undertake to follow through a period of time a group of identical families during and subsequent to their period on relief. It is aimed to examine the transitional process by which families move from relief to care by other agencies or to a position of self-sufficiency in private employment. From five to seven thousand families will be included in the sample studied. Information is to be obtained on adequacy and effectiveness of relief measures administered through state and city boards; effectiveness of the Works Program in providing means of support; relative employment opportunities provided by individual industries and the shift from one industry to another; the shift from one occupational group to another; the amount of shift of the needy cases from one agency or program to another; and the effects of these shifts upon the cases involved.

The *Rural Current Change Survey* consists of several studies conducted in a carefully selected sample of 331 counties in 33 States: (a) cross-section surveys made in February, June, and October 1935, and (b) analyses of cases coming on and going off the relief rolls made for the intervening months; these two aspects of the survey will be discontinued after the December 1935 report and will be replaced by (c) a new study of the post-relief status of rural relief cases closed after June 1935, covering approximately 7,000 families in seven States; (d) an analysis has been made of the industries supplying the employment which was responsible for the closing of 277,000 rural relief cases from March through June 1935.

Two bulletins have been issued on changes in the rural relief load, "The Trend of Rural Relief" and "Changes in the Rural Relief Population Through October 1935." A comprehensive report is being prepared on farmers on relief and rehabilitation; the analysis will include such topics as mobility, family composition, occupational shifts, and bases for selection of rural rehabilitation clients.

Reports are now being prepared upon three rural sample surveys made in

1935. The first was a *Study of Farm Rehabilitation Problems* in the drought area of the West. The second was an examination of the possibilities for rehabilitating *Rural Relief Families in Combined Farming-Industrial Employment*; this study brings together pertinent data from secondary sources and has been supplemented by an extensive field survey covering seven counties in the Eastern Cotton Area. The third is a *Study of the Plantation-Tenant Situation in the South* and its implications for the administration of rural relief and rehabilitation programs.

*Surveys of Transients.* The analysis of a study of migrant family groups is making available for the first time a detailed description of this mobile relief population. The study is based upon a representative sample of family groups receiving care from transient bureaus in 85 cities throughout the U.S. The first of a series of bulletins derived from this study has been issued; it is concerned with the composition, size, and the employability of the economic head of migrant family groups.

The final report on the study of transient service bureau cases has been completed and sent to the printer. This report will appear in research monograph form under the title of "The Transient Unemployed."

A general descriptive bulletin entitled "On Relief" has been widely distributed; it includes 21 pictograph charts describing various aspects of the relief problem. A similar bulletin is now being prepared relating to relief and non-relief youth.

A bulletin containing estimates on the number of youth on relief in May 1935 has been released, giving information on urban and rural youth by age, sex, and race, and youth being cared for under transient and C.C.C. programs.

Research Monograph I—"Six Rural Problem Areas: Relief, Resources, Rehabilitation" has been given wide distribution.

COÖRDINATING COMMITTEE OF THE CENTRAL STATISTICAL BOARD AND THE WORKS PROGRESS ADMINISTRATION.—On November 22, 1935, Charles F. Beach was appointed Chairman, vice Stuart A. Rice resigned. During the six months period of operation ending January, a total of 3,147 statistical, survey, and research projects, calling for expenditures of more than \$320,000,000, were received. In addition to the statistical projects, the Committee examined between 900 and 1,000 projects which it ruled non-statistical. Final action has been taken on more than 2,500 of the statistical projects. Approximately three-fourths of those reviewed have been disapproved because of duplication of subject matter, of respondents or both, or because of technical inadequacy, or because they were not administratively feasible. The current inspection and advisory service to sponsors of approved projects is being maintained through the use of State Statistical Coördinators, Regional Research Supervisors, and the Washington field staff.

CENTRAL STATISTICAL BOARD.—A *Directory of Federal Statistical Agencies* has been prepared to supersede the *Directory of Statisticians of the United*

States Government published by the Central Statistical Board in January 1935.

UNIVERSITY OF OXFORD.—An Institute of Statistics has been established at Oxford under the direction of Mr. J. Marschak. The Institute will attempt, in coöperation with other University institutions, to promote social research on its empirical and quantitative side. It will therefore assist persons doing social research work in Oxford (senior members as well as students): (a) by building up a library which will comprise books, periodicals, and a collection of documents; (b) by preparing and keeping continually up to date detailed lists of sources relevant to the specific subjects under research; and by providing sources not yet available in Oxford; (c) by discussing and executing jointly with the individual researchers such work of statistical estimation and computation as is required for the completion of the empirical and quantitative side of the research in hand.

It is hoped that this assistance and these advisory activities will also substantially help to coördinate work done by individual researchers, and encourage economists to strengthen the empirical and quantitative side of their work.

Members of the sub-Faculty of Economics have expressed, on various occasions, the wish to coöperate, especially in the field of Economic "Dynamics" (Trends and Cycles). No centralized investigation according to a rigid programme can, however, be promised for the early years of the existence of the Institute, until such time as a group of younger researchers has been trained for and interested in empirical work; and until funds (after the completion of the greater part of the capital equipment) can be made available for the payment of a full-time research staff. The theoretical interests which prevail at present among the senior researchers in Oxford do not permit of a strict organization. But it is thought that the statistical and empirical side of their work may be materially aided, and team work fostered, on the lines described in the first paragraph.

It would therefore be a mistake to compare the activities of the Institute, at the beginning, with the centralized work which is being done by the full-time staff of such organizations as the Oxford Agricultural Economics Research Institute; the National Bureau of Economic Research, in New York; the Brookings Institution, in Washington; the Institut für Weltwirtschaft, Kiel; etc.

The teaching of Statistics as applied to the Social Sciences requires a much more extensive and more easily accessible supply of sources than has hitherto been available in Oxford. It is hoped that the Institute will help to develop the knowledge of sources and the skill in using them and to prepare future investigators.

UNIVERSITY OF PARIS.—Dr. Jerzy Neyman delivered in January, 1936, a series of six lectures at the Henri Poincaré Institute on "Problems of Statistical Estimation and the Verification of Hypotheses."

**AMERICAN MATHEMATICAL SOCIETY.**—A symposium on mathematical statistics will be held at Columbia University on April 11, 1936 by the American Mathematical Society. In addition to short papers and discussion the program will include the following four addresses: "Methods of Obtaining Probability Distributions," by Burton H. Camp; "The Method of Maximum Likelihood," by Harold Hotelling; "The Characterization of a Distribution Function Through Its Moments," by J. Shohat; and a paper by S. S. Wilks.

## PERSONAL NOTES

Mr. Wilbert G. Fritz, Financial Economist of the Bureau of Business Research, University of Pittsburgh, has been granted a leave of absence for the coming year to continue his studies at Columbia University, where he has been awarded a University Fellowship for work in statistics and economics.

Mr. Theodore A. Veenstra, Statistician of the Bureau of Business Research, University of Pittsburgh, has returned to his work after a year's leave of absence, during which he was first with the State Emergency Relief Board at Harrisburg and later with the Federal Housing Administration in Washington.

Dr. Horatio M. Pollock, Dr. Benjamin Malzberg and Mr. Raymond G. Fuller are making a comprehensive study of heredity and environmental factors in the causation of dementia praecox and manic-depressive psychoses. The study deals with original material collected by field studies made possible by a grant from the Laura Spelman Fund. Installments of the study have been appearing in the *Psychiatric Quarterly*. When complete, they will be brought together and published in book form.

## NEW MEMBERS

Berrett, Roger W., Managers Clerk, American Steel & Wire Company, 94 Grove Street, Worcester, Massachusetts

Blakey, Dr. Roy G., Director, Division of Economic Research, Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C.

Bookholtz, Mrs. H. E., Research Assistant, Trade Association Section, Division 50, Department of Commerce, Washington, D. C.

Bowman, Dr. Raymond T., Assistant Director of Research and Statistics, Pennsylvania State Emergency Relief Administration, Harrisburg, Pennsylvania

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Brown, Pamela, Assistant Statistician, Federal Emergency Relief Administration, Washington, D. C.

Byrd, C. D., Assistant Statistician, American Gas Association, 420 Lexington Avenue, New York City

Byrne, Harriet A., Associate Social Economist, Women's Bureau, Department of Labor, Washington, D. C.

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- Cella, Raymond, Statistical Clerk, Agricultural Adjustment Administration, Lexington, Kentucky
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- Cornatleanu, Dr. Nicolae, Professor, Department of Agricultural Economics, Cornell University, Ithaca, New York
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- Fridinger, Arthur B., Associate Statistician, National Recovery Administration, Washington, D. C.
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- Goor, Charles G., Junior Statistician, The Railroad Retirement Board, Tower Building, Washington, D. C.
- Goudriaan, Dr. Ir. J., Sub-manager, N. V. Philips' Glowlamp Works, Eindhoven, Holland
- Greig, Gertrud, Statistician, Works Progress Administration, Washington, D. C.
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- Harold, Miriam S., Member of Technical Staff, Bell Telephone Laboratories, 463 West Street, New York City

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- Lamon, Russell, Investment Supervisor, Edie-Davidson, Inc., 1506-1512 Lincoln Liberty Building, Philadelphia, Pennsylvania
- Lehner, Joseph, Retail Merchandising, R. H. Macy and Company, Inc., 34th Street and Broadway, New York City
- Lehtinen, Arthur, Assistant Director, Bureau of the Economic Defense Council, Cornell University, Ithaca, New York
- Lerner, E. R., Research Assistant, Central Statistical Board, 7028 Commerce Building, Washington, D. C.
- Linder, Dr. Forrest E., Bureau of the Census, Division of Vital Statistics, Washington, D. C.
- McClure, Howard H., Director, Division of Current Business Statistics, Central Statistical Board, 7834 Commerce Building, Washington, D. C.
- Marquardt, Mary O., 415 West 120th Street, New York City
- Nelson, W. Linton, Treasurer, The Investment Corporation of Philadelphia, 225 South 15th Street, Philadelphia, Pennsylvania
- Neufeld, Milton, Financial Statistician, Emergency Relief Bureau, City of New York, 902 Broadway, New York City
- Neyman, Dr. Jerzy, Reader, Department of Applied Statistics, University College, London, W. C. I., England
- Osborn, Frederick, Research Associate in Anthropology, American Museum of Natural History, 52 Broadway, New York City
- Ozer, Dr. Sol D., Chief, Section on Procedures, Finance and Statistics, Division of Professional and Service Projects, Works Progress Administration, Washington, D. C.
- Parrott, D'Arcy, Investment Analyst, Messrs. Fahnestock & Company, 1 Wall Street, New York City
- Patton, Archibald, A., Statistician, Associated Press, 383 Madison Avenue New York City
- Peyton, William E., 2836 Meade Avenue, San Diego, California
- Phelps, Dr. D. M., Assistant Professor, Tappan Hall, University of Michigan, Ann Arbor, Michigan
- Randall, Alexander B., Technical Adviser, State Housing Authority of New Jersey, 1060 Broad Street, Newark, New Jersey
- Reed, Dr. Harold L., Professor of Economics, Cornell University, Ithaca, New York
- Ring, Jacob, 229 East 7th Street, New York City
- Royer, Dr. Elmer B., Director of Admissions, Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma

- Schwartz, S. S., Administrative Assistant for Research and Statistics, Philadelphia County Relief Board, 112 North Broad Street, Philadelphia, Pennsylvania
- Seiger, Benjamin M., Associate Chief, Records-Reports-Statistics Section, Division of Project Control, Works Progress Administration, Washington, D. C.
- Shearon, Dr. Marjorie, Senior Analyst, Division of Research and Statistics, Works Progress Administration, Washington, D. C.
- Shmied, Ernest A., 2801 Park Avenue, Minneapolis, Minnesota
- Shreiner, John F., Statistician and Investment Analyst, Wm. J. Mericka & Company, 1836 Union Trust Building, Cleveland, Ohio
- Silliman, Betty F., Inter-Ocean Reinsurance Company, Post Office Drawer #31, Cedar Rapids, Iowa
- Smith, Dorothy E., Statistical Clerk, National Recovery Administration, La Salle Building, Washington, D. C.
- Steinbach, Milton, Partner, Wertheim & Company, 120 Broadway, New York City
- Taylor, Burton W., Instructor, Department of Sociology, Syracuse University, Syracuse, New York
- Torrance, Charles M., Principal Clerk, Division of Research and Statistics, Federal Home Loan Bank Board, Washington, D. C.
- Toteff, Anastas U., Graduate Student, Cornell University, Ithaca, New York
- Varley, Dimitry V., Statistician, New York State Employment Service of the New York State Department of Labor, 124 East 28th Street, New York City
- Webster, Lawrence P., 1571 Taylor Avenue, New York City
- Williamson, W. Rulon, Assistant Actuary, Life Actuarial Department, The Travelers Insurance Company, 700 Main Street, Hartford, Connecticut
- Wing, George J., 414 Summit Avenue, Oconomowoc, Wisconsin
- Woytinsky, Wladimir S., Member of Staff and Consultant for Social Security, Central Statistical Board, 7024 Commerce Building, Washington, D. C.
- Yerushalmy, Dr. Jacob, Statistician, State Department of Health, Albany, New York
- Zwackl, Oscar, Assistant Engineer, Valuation Department, Lehigh and New England Railroad Company, 642 Main Street, Bethlehem, Pennsylvania

PROCEEDINGS OF THE NINETY-SEVENTH ANNUAL MEETING

COMMODORE HOTEL, NEW YORK CITY

PROGRAM

FRIDAY, DECEMBER 27, 1935

10:00 A.M.—I. THE NEW DEAL AND THE INVESTOR

Chairman: Roland P. Falkner, National Industrial Conference Board

Speakers: Bernhard Ostrolenk, City College, New York

John T. Madden, New York University

Discussant: Dean Langmuir, Dean Langmuir, Inc., New York City

THE FOUNDATIONS OF AMERICAN WEALTH AND INDUSTRIAL SUPREMACY

Speaker: Carl Snyder, New York City

Discussant: W. W. Cumberland, Wellington & Co., New York City

10:00 A.M.—II. EVALUATION OF RESEARCH WORK DONE UNDER THE EMERGENCY RELIEF PROGRAMS

Joint Session with American Sociological Society

Chairman: R. Clyde White, Indiana University

*Administering Relief Through Research Work*

Howard B. Myers, Federal Emergency Relief Administration

*Significant Developments in Social Research under the FERA*

C. Horace Hamilton, North Carolina State College

*The Coordinating Committee of the Central Statistical Board and the Works Progress Administration*

Charles Beach, Works Progress Administration

Discussant: R. W. Murchie, University of Minnesota

10:00 A.M.—III. RECENT DEVELOPMENTS IN COLLECTION OF INDUSTRIAL STATISTICS

Chairman: Arynness Joy, Central Statistical Board

*N.R.A.'s Statistical Experience*

Theodore J. Kreps, Stanford University

*Wanted: New Industrial Statistics*

Willard Thorp, Dun & Bradstreet

*Post-N.R.A. Machinery for Collection of Industrial Statistics*

Stephen DuBrul, General Motors Corporation

*The Central Statistical Board's Program for Industrial Statistics*

Howard McClure, Central Statistical Board

10:00 A.M.—IV. ROUND TABLE ON STATISTICS OF MARKETING

Chairman: Roland S. Vaile, University of Minnesota

*The New Retail Price Indexes of the Bureau of Labor Statistics*

Stella Stewart, U. S. Department of Labor

*Size of Samples in Marketing Surveys*

Theodore H. Brown, Harvard University

*Retail Price Dispersion*

John H. Cover, University of Chicago



## FRIDAY, DECEMBER 27, 1935

## 12:30 P.M.—LUNCHEON MEETING

Committee on Census Enumeration Areas

Chairman: Howard W. Green, Cleveland Health Council

## 12:30 P.M.—LUNCHEON MEETING

Joint Session with Committee on Economic Accord

Chairman: Fred R. Fairchild, Yale University

*The Need for Economic Accord*

W. Randolph Burgess, Federal Reserve Bank of New York

*The Mechanics of Ascertaining What Economists Believe*

Earl E. Muntz, New York University

*Accomplishments in Economic Accord*

William H. Kiekhofer, University of Wisconsin

## 3:00 P.M.—I. THE NATURE OF THE BUSINESS CYCLE

Chairman: Wesley C. Mitchell, Columbia University

*The Shape of the Business Cycle Curve*

Charles E. Armstrong, New York Telephone Co.

*Fluctuating Credit Volume and the Business Cycle*

Frederick R. Ottman, New York University

*Credit Buying as a Cause of the 1929 Crash*

Lyman S. Logan, Economics Statistics, New York City

Discussion: Harold V. Roelse, Federal Reserve Bank of New York

Otto Nathan, New York University

## 3:00 P.M.—II. THE RECOVERY PROGRAM AND AGRICULTURE

Joint Session with American Farm Economic Association

Chairman: Willford I. King, New York University

*The Agricultural Adjustment Act and National Recovery*

Chester C. Davis, Agricultural Adjustment Administration

*Fundamental Significance of the Agricultural Adjustment Concept*

E. G. Nourse, Brookings Institution

Discussion: J. D. Black, Harvard University

J. I. Falconer, Ohio State University

## 3:00 P.M.—III. THE BIRTH RATE OF THE POPULATION ON RELIEF

Chairman: Robert E. Chaddock, Columbia University

*The Measurement of the Rate and of the Effect of Relief*

Frank W. Notestein, Milbank Memorial Fund

*Should Relief Recipients Eschew Parenthood?*Mary Ross, Associate Editor, *The Survey*

Discussion: Henry Pratt Fairchild, New York University

Samuel A. Stouffer, University of Chicago

## 6:30 P.M.—DINNER MEETING—UNEMPLOYMENT, RELIEF, THE UNBALANCED BUDGET, AND INFLATION

Chairman: J. Franklin Ebersole, Harvard University

Speakers: Luther A. Harr, Commonwealth of Pennsylvania

Robert M. Haig, Columbia University

John C. Gebhart, National Economy League

Discussion: Norman Lombard, Economic Consultant

Ralph Robey, Columbia University

SATURDAY, DECEMBER 28, 1935

9:00 A.M.—BUSINESS MEETING

10:00 A.M.—I. THE A.A.A.

Chairman: Benjamin H. Hibbard, University of Wisconsin

*The A.A.A. and the Consumers*

Calvin B. Hoover, Duke University

*The A.A.A., the Cotton Growers, and the Ranchmen*

Alonzo B. Cox, University of Texas

*The A.A.A. and the Tenant Farmers*

Norman Thomas, Socialist Party Leader

Discussant: Louis H. Bean, U. S. Department of Agriculture

10:00 A.M.—II. ECONOMIC HISTORY

Chairman: John R. Commons, University of Wisconsin

*The Effect Upon French Prices of John Law's Scheme*

Earl J. Hamilton, Duke University

*Significant Developments in the Field of Money and Banking*

Walter E. Spahr, New York University

*The Real Wages of Skilled Laborers in London from 1729 to Date*

Rufus S. Tucker, Twentieth Century Fund

Discussion: Carl Snyder, New York City

Elizabeth W. Gilboy, Harvard University

10:00 A.M.—III. PROBLEMS OF SAMPLING AND CORRELATION METHODS IN SOCIOLOGICAL RESEARCH

Joint Session with American Sociological Society

Chairman: R. Clyde White, Indiana University

*Suggested Uses of the Method of Multiple Factor Analysis in Sociological Research*

Leonard S. Cottrell, Jr., Cornell University

*Practical Problems of Sampling Procedure*

Frederick F. Stephan, American Statistical Association

Discussant: Paul H. Furfey, Catholic University of America

10:00 A.M.—IV. THE LOGIC OF STATISTICS

Chairman: Frederick C. Mills, Columbia University

*The Statistical View of Nature*

Morris R. Cohen, College of the City of New York

*The Meaning of Probability*

Ernest Nagel, Columbia University

Discussion: Truman L. Kelley, Harvard University

Curt J. Ducasse, Brown University

Henry Margenau, Yale University

S. S. Wilks, Princeton University

12:30 P.M.—LUNCHEON MEETING—ARE OLD AGE PENSIONS WORTH THEIR COST?

Joint Session with American Association for Labor Legislation

Chairman: Stuart A. Rice, Bureau of the Census

Speakers: Edwin E. Witte, University of Wisconsin

Margaret Culkin Banning, Author

## SATURDAY, DECEMBER 28, 1935

## 3:00 P.M.—I. THE N.R.A.

Chairman: Malcolm C. Rorty, American Management Association

*The Effect of the N.R.A. on the Physical Volume of Production*

Leonard Kuvin, National Industrial Conference Board

*The Effect of the N.R.A. on the Consuming Public*

Q. Forrest Walker, R. H. Macy & Co.

*The Effect of the N.R.A. on Corporate Profits*

W. L. Crum, Harvard University

Discussant: Lewis H. Haney, New York University

## 3:00 P.M.—II. STABILIZING OUR BANKING SYSTEM

Chairman: E. A. Goldenweiser, Board of Governors of the Federal Reserve System

*Causes of the Banking Debacle*

Joseph H. Finnegan, New York University

Fred Rubman, Salomon Bros. and Hutzler, New York

Margaret Souers, New York University

*Insurance of Bank Deposits*

Mortimer J. Fox, Jr., Federal Deposit Insurance Corporation

Discussant: Arthur R. Tebbutt, Brown University

## 3:00 P.M.—III. ADMINISTRATION OF UNEMPLOYMENT INSURANCE

Joint Session with American Association for Labor Legislation

Chairman: Edwin E. Witte, University of Wisconsin

*The Role of the Federal Government*

John G. Winant, Social Security Board

*Setting up State Administration*

Glenn A. Bowers, New York State Director of Unemployment Insurance

Discussion: I. M. Rubinow, B'nai B'rith, Cincinnati, Ohio

Clarence A. Kulp, University of Pennsylvania

E. Wight Bakke, Yale University

W. Frank Persons, U. S. Employment Service

## MONDAY, DECEMBER 30, 1935

## 9:00 A.M.—BUSINESS MEETING

## 10:00 A.M.—I. MONEY, PRICES, AND UNEMPLOYMENT

Chairman: Warren M. Persons, Consulting Economist

*Price Decline as a Cause of Unemployment*

Irving Fisher, Yale University

*Does Money Volume Actually Control the Price Level?*

Julius H. Spalding, New York University

Discussion: Lucile Bagwell, New York City

Morris A. Copeland, University of Michigan

Jacob Viner, University of Chicago

MONDAY, DECEMBER 30, 1935

10:00 A.M.—II. PUBLIC HEALTH PROBLEMS

Chairman: Edgar Sydenstricker, Milbank Memorial Fund

*Plans for Development of the Vital Statistics Division, Bureau of the Census*  
Halbert L. Dunn, Bureau of the Census

*The Development and Use of Neighborhood Vital Statistics in New York City*  
Marguerite Potter, Department of Health, City of New York

*The Frequency of Vaccinations and Immunizations in Surveyed Families in Eighteen States*

Selwyn D. Collins, U. S. Public Health Service

Discussion: Robert E. Chaddock, Columbia University

Louis I. Dublin, Metropolitan Life Insurance Co.

Godias J. Drolet, New York Tuberculosis and Health Association

Neva R. Deardorff, Welfare Council of New York City

A. W. Hedrich, School of Hygiene and Public Health, The Johns Hopkins University

Dorothy G. Wiehl, Milbank Memorial Fund

10:00 A.M.—III. CURRENT DEVELOPMENTS IN COMMERCIAL BANKING

Chairman: David Friday, Washington, D. C.

*The Quality of Bank Assets*

J. H. Riddle, Bankers Trust Company, New York City

*The Changing Function of Commercial Banking under Security Capitalism*  
George W. Edwards, City College of New York

*Significance of Broadened Lending Powers of Federal Reserve Banks*

E. A. Goldenweiser, Board of Governors of the Federal Reserve System

Discussion: C. O. Hardy, Brookings Institution

W. W. Riefler, Institute for Advanced Study, Princeton, N. J.

Henry C. Simons, University of Chicago

12:30 P.M.—LUNCHEON MEETING—CAUSES OF UNEMPLOYMENT

Chairman: Richard T. Ely, Institute for Economic Research

*Relief as a Cause of Unemployment*

George B. Chandler, Ohio Chamber of Commerce

*Unemployment Insurance and Unemployment*

Malcolm C. Rorty, American Management Association

3:00 P.M.—I. UNEMPLOYMENT

Chairman: William F. Ogburn, University of Chicago

*The Effect Upon Employment of Regulating Hours and Wage Rates*

Robert H. Armstrong, Real Estate and Insurance, New York

*Public Works as a Remedy for Unemployment*

Noel Sargent, National Association of Manufacturers

Discussion: Frank G. Dickinson, University of Illinois

Arthur D. Gayer, Barnard College, Columbia University

MONDAY, DECEMBER 30, 1935

## 3:00 P.M.—II. THE TECHNIQUES OF IMPROVING STATISTICAL TEACHING AND PRACTICE

Chairman: Herbert A. Toops, Ohio State University

*The Improvement of Statistical Techniques in Biology*

George W. Snedecor, Iowa State College

*Psychological Improvements in Statistical Practice*

Harold A. Edgerton, U. S. Employment Service

*Statistical Issues in Scientific Thinking*

Truman L. Kelley, Harvard University

*Needed Improvements in the Methods of Teaching Statistics*

Helen M. Walker, Teachers College, Columbia University

*The Improvement of Statistical Textbooks*

Wendell Vreeland, Wayne University

## 3:00 P.M.—III. RECENT DEVELOPMENTS IN FINANCIAL STATISTICS

Chairman: Harold L. Reed, Cornell University

*A Broadened Program of Bank Reports*

Mortimer J. Fox, Jr., Federal Deposit Insurance Corporation

*New Member Bank Statistics*

J. E. Horbett, Board of Governors of the Federal Reserve System

*New Reports from Security Brokers and Dealers*

Carl E. Parry, Board of Governors of the Federal Reserve System

*Statistics Relating to Security Markets and Corporations*

Paul P. Gourrich, Securities and Exchange Commission

*Recent Developments in Corporate Earnings*

Leland Rex Robinson, International Securities Corporation

Discussion: William J. Carson, University of Pennsylvania

W. L. Crum, Harvard University

W. W. Cumberland, Wellington and Co., New York City

Wilford J. Eiteman, Albion College

## 3:00 P.M.—IV. STATISTICAL TECHNIQUE

Joint Session with the Econometric Society

Chairman: Donald R. Belcher, American Telephone Co.

*Generalized Multiple Correlation for Pairs of Sets of Economic Variates*

Harold Hotelling, Columbia University

*The Significance of Points of Inflection in the Determination of Cyclical Variation*

Walter A. Baude, University of Cincinnati

*Some Problems in Time Series Analysis*

Victor S. von Szeliski, National Recovery Administration

Discussion: (a) Theoretical Significance of Papers

S. S. Wilks, Princeton University

(b) Practical Significance of Papers

Robert W. Burgess, Western Electric Co.

MONDAY, DECEMBER 30, 1935

8:00 P.M.—PRESIDENTIAL ADDRESSES

Joint Session with American Sociological Society and American Association for Labor Legislation

Chairman: Lindsay Rogers, Columbia University

*Social Theory and Social Action*

F. Stuart Chapin, American Sociological Society

*Expressing Social Theory in Legislation*

Joseph P. Chamberlain, American Association for Labor Legislation

*Consolidating Our Gains*

Willford I. King, American Statistical Association

TUESDAY, DECEMBER 31, 1935

10:00 A.M.—I. PRICE CHANGES ANALYZED

Chairman: George F. Warren, Cornell University

*Effect of Gold Price Change on the Prices of Other Goods and on International Trade*

Salem Shapiro, New York University

Marvin M. Wolfsey, New York University

Joseph Lehner, New York University

George Eder, Standard Statistics Company

*Price Volatility and Flexibility*

Paul M. Densen, Johns Hopkins University

*The Quantitative Measurement of the Causes of Certain Price Changes*

Frank A. Pearson, Cornell University

Discussant: Arthur G. Peterson, U. S. Department of Agriculture

10:00 A.M.—II. STATISTICAL CONTROLS IN BUSINESS

Chairman: Theodore H. Brown, Harvard University

*The Kind of Information an Executive Needs to Operate a Factory*

Walter F. Titus, International Business Machines Corporation

*Bases of Control for Industrial Operation*

Fairfield E. Raymond, Massachusetts Institute of Technology

*Some Uses of Statistics in Executive Control*

F. Leslie Hayford, General Motors Corporation

10:00 A.M.—III. DEMOGRAPHIC STATISTICS

Joint Session with Population Association of America

Chairman: Louis I. Dublin, President, Population Association of America

*The Evaluation of the Effect Upon Mortality Statistics of the Selection of the Primary Cause of Death*

Halbert L. Dunn, U. S. Bureau of the Census

*Geographic Distribution of Net Reproductive Rates in the United States*

Alfred J. Lotka, Metropolitan Life Insurance Company

*An Empirical Method of Calculating Future Population*

P. K. Whelpton, Scripps Foundation for Research in Population Problems

TUESDAY, DECEMBER 31, 1935

12:45 P.M.—LUNCHEON MEETING—THE OUTLOOK FOR 1936

Joint Session with the New York District Chapter

Chairman: Edwin B. Wilson, Harvard University

Speakers: Lionel D. Edie, Edie-Davidson, Inc., New York

David Friday, National Association of Automobile Manufacturers

Leonard P. Ayres, Cleveland Trust Company

1:30 P.M.—BUSINESS MEETING AND ELECTION OF OFFICERS

## MINUTES OF THE ANNUAL BUSINESS MEETING

A business meeting of the American Statistical Association was held on Saturday, December 28, 1935, at 9:00 A.M. at the Commodore Hotel in New York City. President Willford I. King presided.

William F. Ogburn reported as Representative on the Council of the American Association for the Advancement of Science. He suggested that, since the Council of the A.A.A.S. meets at the time of the Association's Annual Meeting and in a distant city, the Association appoint an alternate who might attend the meetings of the Council when its Representative cannot attend. Mr. Ogburn also suggested that the Association and its sister societies might arrange to meet with the A.A.A.S. more frequently and that the Social Science Research Council might arrange for such a joint meeting. His report was accepted.

Horatio M. Pollock presented the report of the Committee on Statistics of Institutions for Mental and Physical Disorders. His report was accepted.

Thorsten Sellin reported that the Committee on Statistics of Delinquents and Criminals had held no meeting, but through correspondence between its members, it has developed a plan for a research project. It was also continuing its coöperation with the Census Bureau in connection with criminal statistics. This report was accepted.

Meredith B. Givens reported for the Committee on Government Statistics and Information Services. The report was approved with the remark that this Committee had shown a grand record of progress.

Ewan Clague reported for the Advisory Committee to the Secretary of Labor. The report was accepted.

Robert E. Chaddock read the report of the Representatives on the Joint Advisory Committee on the Census. The report was accepted.

William A. Berridge read the report of the Representatives of the American Statistical Association on the Social Science Research Council. The report was accepted.

Irving Fisher announced that the Committee on Fellows had elected unanimously the following Fellows: Donald R. Belcher, Winfield W. Riefler, and Woodlief Thomas.

Howard W. Green presented the report of the Committee on Census Enumeration Areas. The report was accepted.

The report of the Representatives on the Committee to Advise the New York State Department of Social Welfare was given by Ralph G. Hurlin. It was voted to commend the Committee for its excellent work and to accept the report of the Association's Representatives.

The meeting adjourned.

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A business meeting of the American Statistical Association was held on Monday, December 30, 1935, at 9:00 A.M. at the Commodore Hotel in New York City. President Willford I. King presided.



The report of the Committee on Statistics of Relief and Child Care was presented by Neva R. Deardorff and was accepted.

Burton H. Camp read the report of the Committee on Technique and Method. This report was accepted.

George H. Van Buren reported as Representative on the National Conference on Nomenclature of Disease. It was voted to accept his report.

Wesley C. Mitchell presented his report as Representative on the Board of Directors of the Encyclopaedia of the Social Sciences. He moved that the American Statistical Association extend its felicitations and its thanks to all those who had taken part in the Encyclopaedia of the Social Sciences. The motion was passed unanimously.

Donald R. Belcher reported as Representative on the Business Research Council. His report was accepted.

The Secretary read the report submitted by W. A. Shewhart as Representative on the Joint Committee for the Development of Statistical Applications in Engineering and Manufacturing. It was voted to accept the report.

The Secretary read the report of the Illinois State Committee prepared by John H. Cover. It was voted to accept the report and to refer to the Board of Directors for their consideration the specific recommendations which it contained.

The Secretary read three amendments which had been transmitted from the previous Annual Meeting. Unanimous approval was given to each of the three amendments as follows:

The last sentence of Article VI shall be amended to read: "Subsequent appointments shall be made by the President of the Association for terms of five years each, but no members of the Committee may serve two terms in immediate succession."

Article VIII shall be amended to read: "The officers of the Association shall be nominated and elected from the membership of the Association and shall consist of a President, a Secretary-Treasurer, six other Directors, not more than eight Vice-Presidents and the Editor of the JOURNAL. Each of the Vice-Presidents shall be elected to represent a distinct field of statistical interest, the field to be represented by each to be designated by the Board of Directors before the date when the nomination for that position is made. The President, Vice-Presidents, Secretary-Treasurer, and Editor shall be elected each year at the Annual Meeting, the manner of their election being prescribed in Article IX. The six Directors other than the President and Secretary-Treasurer, shall be elected at the Annual Meeting at which this amended Constitution is adopted, two for a term of one year, two for two years, and two for three years. Thereafter, two Directors shall be elected each year for a term of three years, the manner of their election being prescribed in Article IX. These Directors shall not be eligible for re-election until one year has elapsed after leaving office. All elected officers shall take office at the close of the Annual Meeting at which elected. The President,

Directors, and Secretary-Treasurer shall form a Board of Directors for the government of the Association, three of whom shall constitute a quorum at any meeting regularly convened. The Vice-Presidents shall constitute advisers to the President and Secretary in the preparation for annual and special meetings, and in matters concerning the interests of the groups they represent in the membership of the Association.

"In case of the incapacity of the President to act on any occasion, the Secretary-Treasurer shall designate which of the Vice-Presidents shall act as President."

Article IX shall be amended to read: "The President, Secretary-Treasurer, other Directors, Vice-Presidents, and the Editor of the JOURNAL shall be elected in the following manner. The President shall appoint a Nominating Committee of three members, the personnel of which shall be announced in the quarterly publications of the Association at least three months before the Annual Meeting. It shall be the duty of the Nominating Committee to make nominations for officers to be elected at the Annual Meeting and to notify the regular members and fellows by mail of its nominations at least thirty days before the Annual Meeting. Twelve or more regular members or fellows may make nominations for any office by submitting signed petitions to the Secretary of the Association not less than twenty-four hours before the beginning of the business meeting at which the election is scheduled to take place. In case a nomination by petition is made, the Nominating Committee may present to the Annual Meeting the names of one or more additional nominees for the same office.

"When but one person has been nominated for a given office, that person may be elected at the Annual Meeting by a *viva voce* vote. If there are two or more nominations for the same office, it shall be the duty of the Secretary to announce such nominations, and, in this case, the election for this office shall be by secret ballot, and the President shall appoint three judges of election who shall count the ballots, shall decide any questions that may arise as to the validity of any ballot, and shall declare the results of the election. The candidate for any position, receiving a plurality of votes cast for that office shall be declared elected. The President shall vote only in case of a tie vote, in which event he shall cast the decisive ballot."

The Secretary presented a proposed amendment to Article X which reads as follows: "Annual and occasional meetings shall be held at such times and places as the Board of Directors may designate. Any vacancy in office resulting from death, resignation, or other cause shall be filled by election at the next meeting of the Association."

The amendment was to strike out the last eight words and to substitute for them "the Board of Directors." Approval of this amendment was moved and seconded. It was then voted to amend the proposed amendment so that it would make the second sentence of Article X read: "Any vacancy resulting in office by death, resignation, or any other cause shall be filled until the next Annual Meeting by appointment by the Board of Directors. If at the

next Annual Meeting there remains an unexpired term for any of the vacancies so filled, the vacancy shall then be filled for the remainder of the unexpired term by election in the manner prescribed in Article IX."

The original motion as amended was then put and approved unanimously, for transmission to the Annual Meeting of 1936 for final consideration.

A business meeting of the American Statistical Association was held on Tuesday, December 31, 1935, at 1:30 P.M. at the Commodore Hotel in New York City. President Willford I. King presided.

The following resolutions were adopted:

**RESOLVED** that the American Statistical Association congratulates President Willford I. King and extends to him and to the Vice-Presidents, who assisted him, a hearty vote of thanks for the fine program arranged for this Annual Meeting.

**RESOLVED** that the American Statistical Association expresses its gratitude to Mr. A. T. Falk for his very efficient performance of the many arduous tasks involved in making local arrangements for this Annual Meeting and to Mrs. Helen Slade for her excellent work as publicity representative.

**RESOLVED** that the American Statistical Association expresses to the managements of the Commodore Hotel and the Roosevelt Hotel its appreciation of their hospitality and service at the Annual Meeting of 1935.

The reports of the Secretary, Treasurer and Editor were presented and accepted.

The Secretary read the list of nominations made by the Nominating Committee, including one nomination by petition which the Nominating Committee transmitted in accordance with Article IX of the Constitution. The nominations were as follows:

*President:* JOSEPH S. DAVIS

HORATIO M. POLLOCK (*Nominated by petition*)

*Vice-Presidents:*

1. Collection and Classification of Data and Administration of Statistical Agencies

MORRIS A. COPELAND

2. Statistical and Actuarial Methods and Technique, and the Teaching of Statistics

A. R. CRATHORNE

3. Facts and Methods Pertaining to Political Science, Sociology, Social Welfare Problems, and Vital Statistics

GEORGE E. BARNETT

4. Facts and Methods Related to Anthropology, Biometry, Psychology and Education

H. A. TOOPS

5. Facts and Methods Bearing upon Economics and Economic Theory

HENRY SCHULTZ

6. Facts and Methods Pertaining Primarily to Business

F. LESLIE HAYFORD

7. Facts and Methods Pertaining to Financial Institutions

DONALD M. MARVIN

8. Facts and Methods Pertaining to Marketing

PAUL T. CHERINGTON

*Directors (for a term of three years):* WILLFORD I. KING

H. L. RIETZ

*Secretary-Treasurer:* FREDERICK F. STEPHAN

*Editor of the JOURNAL:* FREDERICK F. STEPHAN

All the nominees with the exception of the nominees for the office of President were elected by *viva voce* vote. The President appointed J. F. Ebersole, Eugene B. Patton and Warren M. Persons as tellers. The vote for the office of President was by ballot. Joseph S. Davis was elected President.

It was moved and seconded that the By-Laws be amended to move the offices of the Association from Washington to New York City. It was then moved and seconded to amend the motion by making it read "The Board of Directors is requested to review its action in moving the office of the Association from New York to Washington and to consider the proposal to return the office of the Association to New York City." The amendment was passed. The original motion as amended was passed.

The meeting adjourned.

FREDERICK F. STEPHAN, *Secretary*

## REPORT OF THE SECRETARY

During 1935, the activities of the Secretary's office have been expanded and preparatory work has been done toward strengthening the committee work of the Association, increasing membership, developing contacts with government statistics, improving organization, and increasing the value of membership. Suggestions and criticisms from district secretaries and many members have helped greatly in planning improvements in our activities. The Secretary has had the privilege of attending meetings of five chapters and visiting the officers of three additional chapters. These and other contacts with officers and members leave a strong impression of the admirable tradition, the fine spirit, and the very promising opportunities of our Association.

During the year, 209 new members were elected. Seven members were lost by death. Sixty-six members resigned and 119 were removed from the membership list for failure to pay their dues (including 19 who had been carried during 1934 and 1935 at their request without paying dues or receiving the JOURNAL). These changes and reinstatements brought the membership list to 1,742 members on December 1, 1935, an increase of 119 members since the report a year ago. The number of subscribers increased from 474 to 521.

During December, 1935, 14 new members were elected, 7 members were reinstated, the resignations of 10 members took effect and one member was lost by death. At the end of the year, there were 1,751 members, as follows:

MEMBERSHIP STATEMENT, DECEMBER 31, 1935			
Honorary members			21
Corporate members			5
Fellows:			
Contributing member	1		
Life members	8		
Other Fellows	78		87
Regular members:			
Life members	21		
Other regular members	1,617	1,640	
Total membership			1,751

The following deaths were recorded during the year: Mr. Edward M. Carbon, Professor C. V. L. Charlier, Miss Margaret H. Hogg, Mr. J. Fred Kistler, Mr. J. Herbert Leighton, Mr. Nelson T. Mann, Mr. J. C. Nevin, and Professor Frank H. Streightoff.

During the year charters were issued to the New York District Chapter and the Washington Statistical Society. There were 58 Chapter meetings during the year, as follows: Albany 6, Austin 0, Boston 1, Chicago 6, Cleveland 7, Columbus 0, Connecticut 8, Los Angeles 0, New York 4, Philadelphia 5, Pittsburgh 11, San Francisco 6, and Washington 4.

A Handbook was published and mailed to members as Part 2 of the September number of the JOURNAL. As a result of taking bids for printing the JOURNAL, unit costs have been reduced and an additional 160 pages were published this year without increasing the total printing bill in comparison with last year. Charges for reprints were reduced materially.

With the support of a grant of \$7,500 from The Rockefeller Foundation, the Association has been able to strengthen its regular work, to plan for expanding its committee activities, and to make substantial progress toward an enlarged usefulness to its members, to government statistical services, and to the users of statistics. In November, the Directors applied for a further appropriation of \$22,500 to enable the Association to continue its enlarged program while it was developing support for the program from regular sources of income. The Rockefeller Foundation has granted this request. The Directors and officers are working to advance the program and direct it toward goals which are of concern to the members. Active participation by many members is necessary if the Association is to realize its opportunities to serve statistics and statisticians.

FREDERICK F. STEPHAN, *Secretary*

#### REPORT OF THE TREASURER

This report covers a period of thirteen months, December 1, 1934, to December 31, 1935. It includes the month of December, 1934, during which Dr. Willford I. King was Treasurer. A statement of receipts and expenditures is given for the fiscal year beginning December 1, 1934, and for the month of December, 1935, in addition to the thirteen month period. Beginning January 1, 1936, the fiscal year will be the calendar year. This change makes the fiscal year conform with the year used for dues, subscriptions, volumes of the JOURNAL and the term of office of the Treasurer.

In comparisons with previous years, it should be noted that the flow of receipts is heavy in the spring and low at the end of the year. Expenses are heaviest just before and just after the Annual Meeting. The thirteen month period includes expenditures for five issues of the JOURNAL. Consequently, the figures for the fiscal year should be used rather than those for the thirteen month period. Considering the fiscal year, receipts exceeded expenditures by about \$800.00, exclusive of the purchase and sale of securities. A balance sheet for December 31, 1935, and statements of receipts, expenditures, and balances are attached.

FREDERICK F. STEPHAN, *Treasurer*

AMERICAN STATISTICAL ASSOCIATION  
BALANCE SHEET

*December 31, 1935*

ASSETS

Current Assets and Investments:

Cash		
Checking account (American Security and Trust Company).....	\$ 1,994.35	
Savings account (Emigrant Industrial Savings Bank).....	359.44	
Petty cash.....	13.86	\$ 2,367.65
Investments (market value, December 31, 1935).....		8,099.00
Receivables		
Accrued interest.....	\$ 16.79	
Accounts receivable.....	67.50	
Dues receivable, less doubtful items.....	150.00	234.29
Inventories		
JOURNAL, volumes 1 to 30, inclusive.....	\$ 1,500.00	
Special publications.....	35.00	1,535.00
Furniture and Equipment, less depreciation.....		648.18
Total assets.....		<u>\$12,884.12</u>

LIABILITIES AND SURPLUS

Current Liabilities:

Unearned income		
Dues received for 1936 and following years.....	\$ 795.91	
Subscriptions received for 1936 and 1937.....	1,608.00	
Miscellaneous credits.....	29.33	\$ 2,433.24
Bills payable.....		0.00
Liability on account of life memberships.....		1,980.00
Corporate Surplus.....		8,470.88
Total liabilities and surplus.....		<u>\$12,884.12</u>

AMERICAN STATISTICAL ASSOCIATION  
STATEMENT OF RECEIPTS, EXPENDITURES AND CASH BALANCES  
*Thirteen Months, December 1, 1934, to December 31, 1935*

DECEMBER 1, 1934 TO NOVEMBER 30, 1935

Cash on hand, December 1, 1934:		
Checking account (Corn Exchange Bank Trust Company).....	\$ 1,256.20	
Savings account (Emigrant Industrial Savings Bank).....	350.62	
Cash and checks, not deposited.....	170.28	\$ 1,777.10
<hr/>		
Net cash receipts, December 1, 1934, to November 30, 1935:		
General account.....	\$19,071.54	
Special account: The Rockefeller Foundation Grant.....	7,500.00	26,571.54
<hr/>		
Total.....		\$28,348.64

Net cash expenditures, December 1, 1934, to November 30, 1935:		
General account.....	\$17,479.27	
Special account: The Rockefeller Foundation Grant.....	6,632.96	
Special account: Committee on Calendar Reform..	326.86	\$24,439.09
<hr/>		
Cash on hand, November 30, 1935:		
Checking account (American Security and Trust Company).....	\$ 3,541.66	
Savings account (Emigrant Industrial Savings Bank).....	359.44	
Petty cash.....	8.45	3,909.55
<hr/>		
Total.....		\$28,348.64

DECEMBER 1 TO 31, 1935

Cash on hand, December 1, 1935.....		\$ 3,909.55
Net cash receipts, December, 1935:		
General account.....		1,275.04
<hr/>		
Total.....		\$ 5,184.59
<hr/>		
Net cash expenditures, December, 1935:		
General account.....	\$ 1,949.90	
Special account: The Rockefeller Foundation Grant.....	867.04	\$ 2,816.94
<hr/>		
Cash on hand, December 31, 1935:		
Checking account (American Security and Trust Company).....	\$ 1,994.35	
Savings account (Emigrant Industrial Savings Bank).....	359.44	
Petty cash.....	13.86	2,367.65
<hr/>		
Total.....		\$ 5,184.59



AMERICAN STATISTICAL ASSOCIATION  
STATEMENT OF CASH RECEIPTS AND EXPENDITURES  
*Thirteen Months, December 1, 1934, to December 31, 1935*

	Thirteen Months Period	Fiscal Year Dec. 1, 1934 to Nov. 30, 1935	Month of December 1935
<b>Receipts:</b>			
Dues.....	\$ 9,301.41	\$ 8,992.41	\$ 309.00
Subscriptions.....	4,030.32	3,131.45	898.87
Advertising.....	138.00	138.00	—
Reprints.....	452.53	452.53	—
Payments by authors.....	52.50	52.50	—
JOURNAL sales.....	312.70	311.20	1.50
Books and monographs.....	135.21	132.71	2.50
Dividends and interest.....	763.82	701.07	62.75
New York meetings.....	176.62	176.62	—
Sale of furniture.....	60.00	60.00	—
Miscellaneous receipts.....	70.93	70.51	.42
The Rockefeller Foundation grant...	7,500.00	7,500.00	—
Total receipts, exclusive of sale of securities.....	\$22,994.04	\$21,719.00	\$1,275.04
Sale of securities.....	4,852.54	4,852.54	—
Total receipts.....	<u>\$27,846.58</u>	<u>\$26,571.54</u>	<u>\$1,275.04</u>
<b>Expenditures:</b>			
JOURNAL: printing, mailing and reprints.....	\$ 6,325.03	\$ 5,448.86	\$ 876.17
Salaries and wages.....	11,501.47	10,505.59	995.88
Rent.....	1,128.00	1,038.00	90.00
Office supplies, printing, addressographing and mimeographing.....	984.79	690.38	294.41
General postage and carriage.....	545.36	506.63	38.73
Telephone and telegraph.....	196.98	150.74	46.24
Travel expense.....	1,152.92	788.88	364.04
Furniture and equipment.....	684.82	596.00	88.82
Old JOURNALS purchased.....	305.41	297.06	8.35
Storage of old JOURNALS.....	126.06	126.06	—
Books for sale.....	83.27	82.52	.75
New York meetings.....	304.53	304.53	—
Miscellaneous expense.....	295.14	281.59	13.55
Refund: Committee on Calendar Reform Account.....	95.40	95.40	—
Total expenditures, exclusive of purchase of securities.....	\$23,729.18	\$20,912.24	\$2,816.94
Purchase of securities.....	3,526.85	3,526.85	—
Total expenditures.....	<u>\$27,256.03</u>	<u>\$24,439.09</u>	<u>\$2,816.94</u>

AMERICAN STATISTICAL ASSOCIATION

STATEMENT OF BALANCES AND ANALYSIS OF CASH EXPENDITURES BY ACCOUNTS

*Thirteen Months, December 1, 1934, to December 31, 1935*

	General Account	Special Account: The Rocke- feller Foundation Grant*	Special Account: Committee on Calendar Reform
Balance, December 1, 1934.....	\$ 1,450.24	\$ 0.00	\$326.86
Net cash receipts, December 1, 1934, to December 31, 1935.....	20,346.58	7,500.00	0.00
Total.....	<u>\$21,796.82</u>	<u>\$7,500.00</u>	<u>\$326.86</u>
Net cash expenditures, December 1, 1934, to December 31, 1935:			
JOURNAL: printing, mailing and re- prints.....	\$ 6,243.57	—	\$ 81.46
Salaries and wages.....	6,488.75	4,872.72	140.00
Rent.....	312.00	816.00	—
Office supplies, printing, addresso- graphing and mimeographing.....	894.48	90.31	—
General postage and carriage.....	501.46	43.90	—
Telephone and telegraph.....	143.28	53.70	—
Travel expense.....	149.82	1,003.10	—
Furniture and equipment.....	138.75	546.07	—
Old JOURNALS purchased.....	305.41	—	—
Storage of old JOURNALS.....	126.06	—	—
Books for sale.....	83.27	—	—
New York meetings.....	304.53	—	—
Miscellaneous expense.....	210.94	74.20	10.00
Refund to World Calendar Reform Association and International Fixed Calendar League.....	—	—	95.40
Purchase of securities.....	3,526.85	—	—
Total expenditures.....	<u>\$19,429.17</u>	<u>\$7,500.00</u>	<u>\$326.86</u>
Balance, December 31, 1935.....	2,367.65	0.00	0.00
Total.....	<u>\$21,796.82</u>	<u>\$7,500.00</u>	<u>\$326.86</u>

\* Appropriated for the calendar year 1935.

#### REPORT OF THE AUDITING COMMITTEE

We have examined the books and records in the office of the Treasurer of the American Statistical Association, have verified the bank balances and have checked the securities on hand.

We hereby certify that the Treasurer's report submitted is in accordance with the books and records, and, in our opinion, correctly represents the financial condition of the American Statistical Association as of December 31, 1935, and receipts and expenditures during the period, December 1 1934, to December 31, 1935.

ARTHUR F. WHITE  
SUSAN S. BURR

#### REPORT OF THE EDITOR OF THE JOURNAL

During 1935, Volume 30 was published with a total of 856 pages, including the Proceedings (218 pages) issued as Part 2 of the March number and the Handbook (70 pages) issued as Part 2 of the September number. Apart from the Handbook, this volume was 90 pages larger than the preceding volume. A survey of progress in mathematical statistics was published in the March issue. The reporting of the statistical activities of government agencies has been expanded.

The Editor wishes to record his appreciation of the fine work performed by Dr. S. A. Stouffer as Acting Editor for the March number and by Dr. Ralph J. Watkins as Review Editor. The cooperation of a number of members who acted as advisers in examining manuscripts was extremely valuable.

FREDERICK F. STEPHAN, *Editor*

**LIST OF COMMITTEES FOR 1935**  
**RESEARCH COMMITTEES**

*Committee to Stimulate and Coordinate Research*

Meredith B. Givens, <i>Chairman</i>	Neva R. Deardorff
Burton H. Camp	Horatio M. Pollock
Morris A. Copeland	Winfield W. Riefler
W. Leonard Crum	Mary van Kleeck

(The President, *ex officio*, the Secretary and the Chairmen of all the Research Committees.)

*Committee on Government Statistics and Information Services*

F. C. Mills, <i>Chairman</i>	Ewan Clague
M. B. Givens, <i>Executive Secretary</i>	J. F. Dewhurst
Donald R. Belcher	Bryce M. Stewart
M. R. Benedict	Samuel A. Stouffer
William J. Carson	Ralph J. Watkins
Robert E. Chaddock	

*Advisory Committee to the Secretary of Labor*

Bryce M. Stewart, <i>Chairman</i>	M. B. Givens
Ewan Clague, <i>Secretary</i>	Ralph G. Hurlin
Morris A. Copeland	Arynness Joy
J. F. Dewhurst	Murray W. Latimer

*Committee on Statistics of Institutions for Mental and Physical Disorders*

Horatio M. Pollock, <i>Chairman</i>	Mary Augusta Clark
G. W. Baehne	Emil Frankel
Frederick W. Brown	Carl E. McCombs
Kate H. Claghorn	David M. Schneider

*Committee on Statistics of Relief and Child Care*

Neva R. Deardorff, <i>Chairman</i>	Philip Klein
F. Stuart Chapin	David M. Schneider
Emil Frankel	Maude E. Stearns
Ralph G. Hurlin	Emma Winslow
Maurice J. Karpf	Helen Witmer

*Committee on Census Enumeration Areas*

Howard W. Green, <i>Chairman</i>	Neva R. Deardorff
Clarence E. Batschelet	R. D. McKenzie
Robert E. Chaddock	Leon Truesdell
Calvert L. Dedrick	

Edwin H. Sutherland

S. A. Stouffer

## Sidney W. Wilcox

**Willard L. Thorp, *Chairman***

**Malcolm C. Rorty** (*For the term expiring December 31, 1939*)

## Irving Fisher

(The President and Secretary, *ex officio*)

**Malcolm C. Rorty**

*Committee on Functional Organization and Classification of Members*

John H. Cover, <i>Chairman</i>	Paul R. Rider
William F. Ogburn	Harry C. Carver
Samuel A. Stouffer	Donald R. G. Cowan
(The Secretary, <i>ex officio</i> )	

*Committee to Appraise the Statistical Evidence of the Causes of the 1929-1932 Business Collapse*

Carl Snyder, <i>Chairman</i>	Willford I. King
S. L. Andrew, <i>Secretary</i>	Wesley C. Mitchell
Leonard P. Ayres	Warren M. Persons
Carroll W. Doten	George E. Roberts
E. Dana Durand	Malcolm C. Rorty
Irving Fisher	Edwin B. Wilson

*Committee on Biometrics and Vital Statistics*

Lowell J. Reed, <i>Chairman</i>	J. V. DePorte
Joseph Berkson	Harry H. Laughlin
Robert E. Chaddock	Alfred J. Lotka
Selwyn D. Collins	Hugo Muench, Jr.
John Collinson	Richard E. Scammon
Edgar Sydenstricker	

*Committee to Receive and Consider the Report of the Social Science Research Council's Commission on Public Service Personnel*

Joseph H. Willits, <i>Chairman</i>	William J. Carson
Asher Achinstein	

*Committee on Special Publications*

Frederick F. Stephan, <i>Chairman</i>	Meredith B. Givens
Harry C. Carver	Frank A. Ross

*State Committee for Illinois*

John H. Cover, <i>Chairman</i>	Simeon Leland
Robert J. Myers	

*State Committee for Pennsylvania*

Ewan Clague, <i>Chairman</i>	William J. Carson
Casimir A. Sienkiewicz	

*Representative on the Board of Directors of the National Bureau of Economic Research*

Malcom C. Rorty

*Representatives on the Joint Committee on the Encyclopedia of the Social Sciences*

Robert H. Coats, *Chairman*

Mary van Kleeck

*Representative on the Board of Directors of the Encyclopaedia of the Social Sciences*

Wesley C. Mitchell

*Representatives on the Joint Advisory Committee on the Census*

Robert E. Chaddock (*For the term expiring December 31, 1935*)

Willford I. King (*For the term expiring December 31, 1936*)

Paul T. Cherington (*For the term expiring December 31, 1937*)

*Members of the Social Science Research Council*

William A. Berridge (*For the term expiring December 31, 1935*)

Seymour L. Andrew (*For the term expiring December 31, 1936*)

Edwin B. Wilson (*For the term expiring December 31, 1937*)

*Representative on the Council of the American Association for the Advancement of Science*

William F. Ogburn

*Representative on the Business Research Council*

Donald R. Belcher

*Representatives on the Committee to Advise the New York State Department of Social Welfare*

Ralph G. Hurlin

Horatio M. Pollock

*Representative on the National Conference on Nomenclature of Disease*

George H. Van Buren

*Representative on the Advisory Committee of the American Year Book*

Samuel A. Stouffer

*Representative on the Joint Committee for the Development of Statistical Applications in Engineering and Manufacturing*

Walter A. Shewhart

## REPORTS OF COMMITTEES AND REPRESENTATIVES

### REPORT OF THE COMMITTEE ON FELLOWS

The Committee on Fellows has elected by unanimous vote the following Fellows: Donald R. Belcher, Winfield W. Riefler, and Woodlief Thomas.

IRVING FISHER

W. L. CRUM

WILLIAM F. OGBURN

EMANUEL A. GOLDENWEISER

MALCOLM C. RORTY

### REPORT OF THE COMMITTEE ON GOVERNMENT STATISTICS AND INFORMATION SERVICES

This Committee has been actively represented in the membership of the Central Statistical Board during 1935 pending the Board's reorganization under independent legislation passed in the last session of Congress. The Committee's general report, which will present general conclusions and a review of activities during a year and a half of staff work, is in manuscript form and it is expected that it will be published during the early spring. With the creation of the new Central Statistical Board, whose establishment has been delayed by the failure of the third deficiency bill, it is expected that the Committee on Government Statistics will be discharged.

As reported previously in these pages, the work of this Committee has covered a wide range of activities touching all of the principal phases of the statistical work of the federal government. As its task is brought to a close it can report to the sponsoring bodies (this Association and the Social Science Research Council) a high degree of satisfaction with the record of progress in official statistics since the summer of 1933.

The great expansion of governmental activity has created new problems of far-reaching importance yet to be solved, and many fundamental and continuing problems (such as that of a standard, multi-purpose industrial classification, for example) have merely been touched, but outstanding improvements in personnel and in professional standards have been achieved, however, and a new and vigorous central agency remains to stimulate and foster further progress along sound and permanent lines. The Committee's conclusions regarding further needs and possibilities will be suggested in its general report which is based on its own and the collaborating work of the Advisory Committee to the Secretary of Labor.

FREDERICK C. MILLS, *Chairman*

MEREDITH B. GIVENS, *Secretary*

DONALD R. BELCHER

MURRAY R. BENEDICT

WILLIAM J. CARSON

ROBERT E. CHADDOCK

EWAN CLAGUE

J. FREDERIC DEWHURST

BRYCE M. STEWART

SAMUEL A. STOUTER

RALPH J. WATKINS



## REPORT OF THE ADVISORY COMMITTEE TO THE SECRETARY OF LABOR

As indicated in previous issues of the JOURNAL, the Advisory Committee to the Secretary of Labor was appointed by the Association jointly with the Social Science Research Council in accordance with a request made by Secretary of Labor Perkins, in March 1933. Later, when the Committee on Government Statistics and Information Services was appointed to serve several other government departments, the Advisory Committee was lent to the larger Committee and shared in the funds which were available through that Committee.

Staff members of the Committee were actively at work in Washington from the summer of 1933 through to the end of 1934. Since that time the activity of the Committee has been confined to the preparation of a written report. In the course of its activities the Committee prepared material for the Department of Labor, generally for the Bureau of Labor Statistics, on the following topics: employment and payrolls; unemployment; wages, hours, and working conditions; employer-employee relations; consumption and living costs; wholesale prices; retail prices; labor turnover; employment offices; industrial accidents; productivity; labor income; immigration; Federal-state cooperation; statistical organization; personnel; and a number of minor topics.

In several of these fields publications have already resulted from the work which was done. Reference may be made to the article by Aryness Joy, "Recent Progress in Employment Statistics," which appeared in the JOURNAL, December 1934; and to one in the *Monthly Labor Review*, September 1935, by Williams, Hogg and Clague, "Revision of Index of Cost of Goods Purchased by Wage Earners and Lower Salaried Workers." Papers were read before the annual meetings of the Statistical Association by Jacob Perlman, Helen Wright, Margaret Hogg, Howard Myers, and several others. In April 1934, a Preliminary Report was presented to the Secretary of Labor. Final publication will occur as part of the General Report of the Committee on Government Statistics, to be published some time in the spring of 1936.

In reporting on its work the Advisory Committee wishes to emphasize the hearty cooperation given to the Committee by Secretary Perkins and Commissioner Lubin. Not only were all the Committee reports and memoranda noted by these officials, but the recommendations submitted were given careful consideration by the operating bureaus. In recent months the Bureau of Labor Statistics has been submitting to the Committee detailed reports of progress, showing the extent to which the Committee's recommendations have been adopted in the work of the Bureau. Where recommendations have not been found practicable, the reasons for the rejection or postponement have been given.

BRYCE M. STEWART, *Chairman*  
EWAN CLAGUE, *Secretary*  
MORRIS A. COPELAND  
J. FREDERIC DEWHURST

MEREDITH B. GIVENS  
RALPH G. HURLIN  
ARYNESS JOY  
MURRAY W. LATIMER

REPORT OF THE JOINT ADVISORY COMMITTEE ON THE CENSUS

There was only one meeting of the Joint Census Advisory Committee in the year 1935—that held on November 22 and 23.

The Committee at this meeting gave consideration to a program of legislation which had been outlined in the Census Bureau and was designed to accomplish the following objectives: (1) codify the legislation which has been enacted since the permanent Census Act of 1902, and provide the legal basis for a unified program of statistical inquiries; (2) coordinate the work of the Bureau to the end that related inquiries are conducted at the same time, or for identical periods; (3) provide an increasing amount of data on a quinquennial and on an annual basis, particularly with regard to the activities of trade and industry; and (4) reduce the severely fluctuating work load now imposed upon the Bureau.

Under this plan the main census inquiries would be covered by comprehensive quinquennial censuses supplemented by annual compilations of more limited scope in intervening years, as indicated by the following resolution which the Committee adopted:

**RESOLVED** that the Committee favors a quinquennial census covering population, agriculture, and such other related subjects as it may be desirable to include, scheduled for the years ending in "0" and "5"; also a quinquennial census of manufactures, mines and quarries, power units, communication, transportation agencies, trade, and services for the years ending in "2" and "7"; also the plan of making such annual compilations as will preserve the continuity of the data obtained in the quinquennial censuses and administer to the needs of other governmental and private agencies by the more frequent reporting of some of the basic data.

Another item on the agenda of the meeting concerned the question of what the Bureau should do about making estimates of population now that the plan for a quinquennial census in 1935 has been rejected and the method of estimating heretofore followed by the Bureau has proven to be inapplicable to existing conditions. This same question was debated in a conference held last September in which representatives of the Population Association of America, the Special Advisory Committee on Vital Statistics and certain officials of the Census Bureau participated. The resolutions adopted at the meeting of the Joint Advisory Committee on the Census follow very closely the recommendations of that conference.

**RESOLVED** that the Committee recommend:

1. That insofar as available information will permit satisfactory estimates:
  - (a) The Bureau of the Census continue to accept the responsibility for making population estimates;
  - (b) Estimates be made for cities having 10,000 or more inhabitants at the 1930 census;
  - (c) Estimates be made for counties or for groups of counties;
  - (d) Estimates be made for the rural population of states and for the population of cities of 2,500 to 10,000 in each state as a group.

2. That in making these estimates, the Bureau of the Census avail itself of all useful material, whether supplied by its own records or derived from other sources.

3. That the methods for constructing the estimates shall be determined by the Bureau of the Census; and that in publishing estimates the Bureau describe the method or methods which have been employed, and indicate the reliability to be expected.

4. That the Bureau of the Census be provided with adequate facilities for making short-term population estimates.

In another resolution the Committee expressed the opinion that the Bureau would not be justified in publishing any more death or birth rates until satisfactory estimates of population are available.

The Committee was disappointed to find that the Bureau's difficulty in obtaining adequate funds for printing its reports, which has been the subject of resolutions adopted at previous meetings, still continues. Of the allotment for the current year nearly one-half had to be used for printing reports which for lack of funds were carried over from the preceding year. The remainder is now practically exhausted, leaving nothing for the reports now ready or to be completed before the end of the fiscal year. In view of this situation the Committee felt compelled to bring this matter again to the attention of the Secretary of Commerce and the Associations which the Committee represents by adopting the following resolutions:

WHEREAS, the Committee has previously expressed its concern over the fact that the funds allotted to the Census Bureau in recent years for printing its reports have regularly been much below the amount requested and found necessary for that purpose; and

WHEREAS, notwithstanding the fact that the Secretary of Commerce succeeded in 1934 in obtaining additional funds sufficient to print the delayed reports that had accumulated up to that time, the Committee finds that the situation has not improved, but rather has become worse; that nearly one-half of the allotment for the current year had to be applied to the printing of reports that had been carried over from the preceding year because of the exhaustion of the funds for that year; that the allotment for the current year is now nearly exhausted; and that for the printing of the reports which will be completed before July 1, 1936, the Bureau needs something like \$40,000 which is not available;

BE IT RESOLVED that the Committee, to its regret, finds itself again compelled to deplore a condition under which, as here illustrated, valuable and costly statistical surveys required or authorized by law are undertaken and conducted without any assurance or certainty that adequate funds for printing the statistics will ever be provided, and that the Committee can but condemn the waste and improvidence displayed by the Government in appropriating money for compiling statistics without making adequate provision for publishing the results of such compilations. Either the Bureau should be provided with funds sufficient to print the results of the statistical compilations which it is authorized or directed by law to make, or else the scope of such compilations should be reduced to come within the limits imposed by the funds that will be available for printing the results.

The Committee followed this by resolution "inviting the attention of the Census Bureau and those responsible for the appropriation or allocation of funds for printing to the possibility of using new processes of reproduction which are more economical than the usual method of printing from type." The Committee had in mind especially the process of "offset printing," and informally approved the use of that process for printing the 1934 Mortality Report already complete in manuscript. The Bureau, in fact, may find it necessary or advisable to use the same process for all the reports that are now ready for publication or will be ready before next July. The list includes

the 1933 biennial report on Manufactures, the 1933 and 1934 reports on Criminal Judicial Statistics, the 1934 reports on Births, Financial Statistics of Cities, Prisoners, Mental Patients, and Mental Defectives, and the 1935 report on Vegetable Fats and Oils—a total of about 2,000 pages.

The Bureau of the Census has for many years published a "Weekly Health Index" giving deaths and death rates for the principal cities of the country, the data being supplied by telegraphic reports sent from the city health office. The question has been raised whether a publication of this kind does not more properly belong in the Public Health Service and overlap or duplicate in some degree the published reports of that Service. It was explained to the Committee that this question had been taken up with a Public Health Service official, and the suggestion made that the publication by the Census Bureau be changed to a monthly, leaving to the Public Health Service the compilation of weekly data. Without expressing any opinion as to what should take its place, the Committee passed a resolution recommending discontinuance of the weekly publication.

EDMUND E. DAY, <i>Chairman</i>	}	Representing the American Economic Association
GEORGE E. BARNETT		
LEO WOLMAN		
ROBERT E. CHADDOCK	}	Representing the American Statistical Association
PAUL T. CHERINGTON		
WILLFORD I. KING		

#### REPORT OF THE COMMITTEE ON CENSUS ENUMERATION AREAS

The Committee on Census Enumeration Areas charged with interesting people in cities of a quarter million or more in census tracts has the following results to report. There were 8 census tract cities in 1910 and 18 in 1930. At the present time 36 of the 37 largest cities in the United States and 11 smaller places have been laid out in census tracts. Four of the members of this Committee have visited eight to ten of the larger cities in an effort to interest people personally in creating and using census tracts for analyzing their population and social statistics. The manual prepared by the Chairman of the Committee and Leon E. Truesdell of the Bureau of the Census has aided people in various cities in preparing the census tract maps and the census tract street indexes.

The Committee held a luncheon and afternoon session Friday, December 27, 1935, to which were invited representatives of census tract cities all over the United States. Six of the seven members of the Committee and 28 guests were present. Fifteen of the 47 census tract cities were represented. "Census Tract Cities" and "Outstanding Uses of Census Tract Data," summarizing the status in each city, were discussed. The Committee is still faced with the problem of getting people in the 47 cities to use the material available by census tracts and to collect additional data by census tracts.

It is suggested that each new publication relating to the application of census tracts in any of the census tract cities be submitted to the Secretary

of the American Statistical Association for review in the quarterly bulletin.

The Committee hopes that it will be possible for the Bureau of the Census to make some tabulations of dollar volume of sales from the Census of Business by census tracts and more detailed data by groups of census tracts. This will make available definite sales data by these geographically constant small areas. The Committee feels that it still faces a problem of working out with the Bureau of the Census a mutually satisfactory and uniform manner of handling the special analyses by census tracts at the time of the next census.

It is believed valuable to continue the activities of this Committee for the promotion of the census tract idea in both new census-tract cities and in those that have census tracts but have not taken full advantage of this "statistical tool."

HOWARD WHIPPLE GREEN, *Chairman*  
C. E. BATSCHELET  
ROBERT E. CHADDOCK  
NEVA R. DEARDORFF  
CALVERT L. DEDRICK  
R. D. MCKENZIE  
LEON E. TRUESDELL

#### REPORT OF THE COMMITTEE ON TECHNIQUE AND METHOD

Your committee has explored projects Nos. 1 and 2, suggested in the minutes of the meeting of the Committee to Stimulate and Coördinate Research, held at Washington, April 6, 1934. These projects were: 1. Monographs on statistical technique; 2. An annual survey and appraisal of new developments in statistical procedure. It has also considered the possibility of inaugurating at the meetings of the American Statistical Association mathematical lectures on somewhat advanced topics in statistics, the lectures to be not for the purpose of describing unpublished research, but for the purpose of disseminating more widely information already available in the literature. Another purpose would be to expose this material, some of which is controversial, for criticism at the meeting. Your committee have expressed their opinions on these subjects by correspondence and have held a meeting at Ann Arbor in September of this year.

With regard to the first project, it appears to be the consensus of opinion that rugged individualism is already succeeding pretty well in producing such monographs as are most desired, but that if projected monographs of high quality should be proposed by authors who could not obtain publishers without subventions, it might then appear desirable for the Association to attempt to find funds to help such publications. It seemed to the committee that the Association should await an initiative on the part of an author rather than take the initiative themselves and select the authors. In this connection a possible new edition of the "Handbook of Mathematical Statistics" was discussed. However, since the royalties of that book go to the

National Research Council, it appeared that the question of a new edition was a matter for the consideration of that Council primarily, but there was a feeling in the committee that a new edition of the "Handbook" might well be desirable.

With regard to the second project, the committee cannot yet render a final report. Considerable progress has been made, however, because Professor Paul Rider, who had been tentatively selected as the author of such an annual survey, is spending a year of study and research at the University of London. The committee authorized Professor Rider to consult with Dr. Irwin with regard to a possible international program of the sort indicated. Already Dr. Irwin's reviews of mathematical statistics in the *Journal of the Royal Statistical Society* are well known and are of very great value. The material is so comprehensive, however, that it appeared likely that Dr. Irwin would like some further help in making these reviews. Professor Rider has now had a considerable opportunity of consulting with Dr. Irwin and his letters indicate that the hopes of the committee in regard to this matter were well founded and it seems quite likely that it will have a definite program to recommend later.

The committee on the whole favored short lecture courses on special topics in mathematical statistics of the sort suggested above.

BURTON H. CAMP, <i>Chairman</i>	WILLIAM F. OGBURN
HARRY C. CARVER	PAUL RIDER
W. LEONARD CRUM	H. L. RIETZ
HAROLD HOTELLING	HENRY SCHULTZ
SIMON KUZNETS	W. A. SHEWHART
FREDERICK C. MILLS	S. A. STOUFFER

#### REPORT OF THE COMMITTEE ON STATISTICS OF INSTITUTIONS FOR PHYSICAL AND MENTAL DISORDERS

The committee has held two meetings during the past year. In general its activities have been the continuation of coöperative projects upon which a preliminary report was made to the Association at the last annual meeting.

In its coöperative work with the Bureau of the Census, your committee has been fortunate in being represented by Frederick W. Brown, who is official adviser of the Bureau in relation to statistics of mental disorders.

A summary of the present status of the work of the 1933 decennial census of institutions may be of interest. Reports of such census completed include those on penal institutions and the one on hospitals for mental diseases. It is expected that the report on institutions for mental defectives and epileptics will be published before March 1, 1936.

The decennial census of hospitals for mental diseases covers a total of 526 hospitals, the same number as were covered in the decennial census of 1922. Eighty-six per cent of such institutions covered in 1933 were state hospitals. The total patient population at the end of the year 1933 was 435,571. During the six years from January 1, 1928, to December 31, 1933,

the total number of patients in residence in the 171 state hospitals increased by 69,006, from 264,511 to 333,517. The ratio per 100,000 of the general population increased from 222.2 to 263.6, an increase of 41.4 per 100,000. In general the report covers the same material as was covered by the 1922 census. The size of the report has, however, been reduced about one-half by the elimination of tables showing detailed comparisons with previous years. The most important comparisons, however, have been retained.

The report on mental defectives and epileptics has also been reduced in size but its material is readily comparable with that of previous reports. This report covers 156 institutions as compared with 136 institutions in the 1922 decennial report. One-half of these 156 institutions are state institutions. The total number of patients on the books of all of these institutions at the end of the year 1933, was 106,764, of whom 100,676, or 94.3 per cent, were in state institutions. During the six year period from January 1, 1928, to December 31, 1933, the total number of resident patients increased by 26,782, from 60,412 to 87,194, and the ratio per 100,000 of population increased from 52.3 to 69.1, or 16.8 per 100,000.

The Bureau of the Census is continuing its work of collecting and publishing annual data from all state mental institutions. The new classification of mental diseases which your committee has approved has been adopted for the 1935 schedules for hospitals for mental diseases. A new schedule, also approved by the committee, showing the distribution of all mentally-defective first admissions by degree of mental deficiency and by the new clinical classification adopted by the American Association on Mental Deficiency in 1933, will be used in the 1935 reports from institutions for mental defectives and epileptics.

The committee's coöperative effort with the Advisory Committee on Research of the New York State Department of Social Welfare has borne excellent fruit. Ralph G. Hurlin, chairman of the Advisory Committee, requested Horatio M. Pollock and David M. Schneider of the committee to prepare the first draft of a handbook for the collection and tabulation of statistical information on hospital in-patient service. This was done with the aid of Dr. Helen R. Jeter. The draft was revised by the Advisory Committee after conference with representatives of the United Hospital Fund of New York City and the Julius Rosenwald Fund. The handbook is now in press and will be ready for distribution about the first of the year.

Your committee acting through a special sub-committee of which Dr. Emil Frankel is chairman, has continued its effort to promote the establishment of a coöperative state and Federal system of welfare statistics. This proposal, which was submitted by the chairman of your committee to the American Public Welfare Association in December, 1935, may be briefly outlined as follows:

1. Purpose. To secure the organization of a national system of welfare statistics in which the Federal government and the several states would coöperate under the guidance of the Federal Census Bureau or other national agency;

## 2. Plan of Procedure.

- a. Study of existing laws and practices in the several states with reference to welfare and institutional statistics;
- b. Preparation in coöperation with the Federal Census Bureau and committees of interested organizations of a general statistical scheme or plan setting forth minimum requirements for adequate welfare statistics. When completed the plan would be submitted to the authorities of the several states;
- c. Preparation of model state law relative to the compilation and dissemination of welfare statistics;
- d. Securing working agreements between the Census Bureau and the authorities of the several states whereby data compiled according to a standard uniform plan would be sent in tabulated form directly to the Census Bureau to be incorporated in a comprehensive national annual report for each principal branch of welfare work;
- e. Securing the establishment of a division of welfare statistics in the Federal Census Bureau;
- f. Securing the establishment by the Federal Census Bureau of a registration area to comprise the coöperating states that render satisfactory reports to the Census Bureau. It would be hoped that the area would gradually be enlarged and would finally include the entire 48 states.

The proposal has met with favor in the American Public Welfare Association and in official agencies at Washington. A guarantee of further progress in this direction is offered in the fact that the former director of the American Public Welfare Association, Mr. Frank Bane, who has recently been called to the post of executive director of the National Social Security Board in Washington, is in sympathy with the project. Your committee feels that the creation of the Social Security Board represents a long forward step toward the compilation of more complete and uniform statistical data on social welfare problems in all fields. Assurance of continued coöperation with the committee's work has already been received from Mr. Bane, and representatives of the committee have been invited to confer with him at an early date.

The manual for hospital accounting and statistics which has recently been issued by the American Hospital Association has received the attention of your committee. This manual should prove of great value in promoting uniform accounting in general hospitals.

The tabulation of hospital discharge schedules in the hospitals of New York City which was undertaken by Dr. Neva R. Deardorff, director of research of the New York City Welfare Council, and chairman of the American Statistical Association's Committee on Statistics of Relief and Child Care will be completed within the next six months. This extremely important piece of research represents the development of an inquiry undertaken by



the earlier Committee on Institutional Statistics, which then included Dr. Deardorff and several members of the present Committee on Statistics of Institutions for Physical and Mental Disorders. As director of research of the New York City Welfare Council, Dr. Deardorff was in position to organize and carry on the study of hospital discharges to advantage, although a member of another committee of the Association.

The Committee on Statistics of Institutions for Physical and Mental Disorders has, however, kept in touch with Dr. Deardorff's work, although with some difficulty, because of her transfer to another committee. She reports that about 600,000 hospital discharge schedules have already been analyzed and that the results of this analysis are now being used in a hospital survey of New York City which is being carried on under the direction of Dr. Haven Emerson. The final reports on Dr. Deardorff's study and on the hospital survey will, it is believed, furnish ample evidence of the practical value of thorough-going statistical analysis in social welfare administration.

In its report for 1934, your committee suggested that the Association give consideration to the proposal of Mr. George W. Baehne of the committee for the establishment of an institute for statistical research. Your committee is much impressed by this proposal and again urges the Association's interest on it. No further report can be made on the matter at this time owing to the absence of Mr. Baehne in Europe.

The committee wishes to note particularly in this report the readiness and completeness with which the United States Bureau of the Census, the American Public Welfare Association, the American Hospital Association, and associate committees of this Association have coöperated in the furthering of its plans for improved social welfare statistics.

G. W. BAEHNE	EMIL FRANKEL
FREDERICK W. BROWN	CARL E. MCCOMBS
KATE H. CLAGHORN	DAVID M. SCHNEIDER
MARY AUGUSTA CLARK	HORATIO M. POLLOCK, <i>Chairman</i>

#### REPORT OF THE REPRESENTATIVE ON THE BOARD OF DIRECTORS OF THE NATIONAL BUREAU OF ECONOMIC RESEARCH

The research work of the National Bureau of Economic Research during 1935 has resulted in the publication of Dr. Harry Jerome's *Mechanization in Industry*, Dr. W. A. Paton's *Corporate Profits as Shown by Audit Reports* and Dr. Arthur D. Gayer's *Public Works in Prosperity and Depression*. Dr. Paton's report was prepared with the coöperation of the American Institute of Accountants; Dr. Gayer's report was made to the National Resources Board of the Public Works Administration.

In addition to these bound volumes, there have appeared five *Bulletins*: "Wages and Hours under the Codes of Fair Competition," by Leo Wolman; "Profits, Losses and Business Assets, 1929-1934," by Solomon Fabricant; "Aspects of Manufacturing Operations during Recovery," by F. C. Mills;

"The National Bureau's Measures of Cyclical Behavior," by W. C. Mitchell and Arthur F. Burns; and "Production in Depression and Recovery," by Charles A. Bliss.

Current research is centered upon Dr. Mitchell's study of business cycles. Other current research includes work on the national income, with present emphasis upon securing a continuous series of estimates for years prior to 1929; a study of the amount and distribution of incomes in selected professions; the completion of the work on capital formation; and the launching of a study of capital consumption by Mr. Fabricant. Dr. Mills has been working on the general subject of prices, and has in preparation a manuscript on the structure of prices during recovery. Mr. Bliss has been working on measures of physical volume of production and data as to the interrelationships of various manufacturing industries. Dr. Wolman is completing a survey of trade union membership, bringing up to date his compilation which appeared as a Bureau report in 1924. Dr. Altschul and his assistant, Dr. Strauss, have continued their studies of agriculture in relation to business cycles. Meanwhile, in Washington, Mr. David L. Wickens has had his staff at work on various materials, compiled by the Bureau of Census and in various C.W.A. projects, which bear upon general questions of real estate financing. The major part of this investigation should be completed this coming year.

Special coöperation on research work has been established during the year with Harvard, Columbia, Pennsylvania, Chicago, Minnesota and Wisconsin Universities. This coöperation will concern itself immediately with questions of prices and of the distribution of wealth and income.

As heretofore, your representative, with other directors of the Bureau, has contributed to its work through a critical reading and annotation of advance copies of its studies.

Attention is called again to the fact that members of the Statistical Association are allowed a 25 per cent discount from list prices of the Bureau publications.

M. C. RORTY

#### REPORT OF REPRESENTATIVES ON THE SOCIAL SCIENCE RESEARCH COUNCIL

The specific interest of the Social Science Research Council is in research leading to new knowledge and understanding of man's life in the midst of a multitude of human relationships and institutions. Around this essential interest lie related and secondary interest with which the Council may regularly or occasionally concern itself. Thus aside from direct research, the Council has regularly sought to perfect the instrumentalities of research through improvement of workers and materials and methods. So also it has on occasion undertaken to render immediate public service by assembling at the disposition of public officials existing resources of knowledge and of men for the solution of technical problems; also, on broader problems of policy and action, to initiate inquiries intended to bring to bear not only

the results of research but all other knowledge and wisdom and opinion that may be available. In both types of aid, the Council has sought to avoid the risks of unduly committing itself—and perhaps, at second remove, its constituent societies—on matters of controversial economic or social policy.

With respect to any enterprise which requires financing, the Council is of course limited by its ability to raise funds. It has become evident that, in order to raise general trust or endowment funds to be expended in its own discretion, it is essential that the Council should itself participate in the selection of its members. A proposal was laid before the Council at its last meeting for nomination by the Council (after consultation with the proper authorities of the American Statistical Association and others of the seven constituent societies) of panels of nominees for election by their respective societies to membership in the Council.

Standing committees have, in 1935, steadily pursued their objectives. Experimental efforts have been initiated to see whether the Council can play a useful rôle in those areas of research for which it is unable to secure any financing. Among the numerous research projects carried on under Council auspices or grants during the year, the major ones have been in the field of population distribution, an enterprise conducted by the Wharton School of the University of Pennsylvania, and in the field of credit and banking in relation to economic stability, a study of real estate financing and the general problem of capital formation, being conducted by the National Bureau of Economic Research. Two major undertakings culminated during the year in the reports of the Commission on National Policy in International Economic Relations and of the Commission on Public Service Personnel. Both Commissions were, immediately on their appointment, given full autonomy; and they, rather than the Council, therefore took the responsibility for the conclusions in their respective reports.

An undertaking of special interest to the American Statistical Association has been that carried on by the *Committee on Government Statistics and Information Services*, established jointly by the Association and the Social Science Research Council. That Committee, designated in June 1933, was most actively at work from then to July 1934, and completed its tasks during the year since elapsed, as is more fully described in the Report of the Committee itself. Although the active staff work of this Committee was terminated on December 31, 1934, the Committee itself has been continued by joint action of the Association and the Council in order to afford opportunity for the completion of its final report and because of the desirability of maintaining committee representation on the Central Statistical Board. This representation is provided for in the Executive Order under which the Board is still functioning because an Act of Congress authorizing a more permanent status was not supplemented by an appropriation of funds for its work.

The Council believes, as apparently does the American Statistical Association also, that through the excellent work of the Committee a highly useful public service has been rendered.

The Council has been fortunate in the matter of special funds for fellowships. During the past year the Committee on Social Science Personnel awarded the eleventh annual series of post-doctoral research training fellowships and two new series of fellowships, the pre-doctoral field fellowships and the pre-doctoral fellowships for graduate study. Appropriations for stipends and allowances totaled approximately \$102,000. A distinct, though related, activity has been the continuance of grants-in-aid.

1. Post-doctoral awards included twelve new appointments for periods of one year each, one new appointment for a period of two years, and two reappointments for a full year.

2. Twenty-six pre-doctoral field fellowship awards were made for periods in 1935-36 varying from nine to twelve months. These fellowships, initiated for the purpose of increasing opportunity for experiential training to supplement more formal graduate study, were open to candidates not over twenty-seven years of age who completed all requirements for the Ph.D. except the thesis and examinations dependent upon it not later than July 1, 1935. The response to this new type of award by graduate students and university faculties, as well as the generally high qualifications of the candidates and their proposed programs, has convinced the committee of the great utility of these fellowships in a program for the development of research personnel in the social sciences.

3. Pre-doctoral fellowships for graduate study, awarded for the first time during the past year, include eight appointments from a total of eighty-six applicants, only seventy of whom completed the examinations required of all candidates at this level. They were open to persons not over twenty-five years of age who held or expected to receive the bachelor's degree not later than July 1, 1935, and had not completed more than the equivalent of one semester's graduate study before the same date.

4. The Committee on Grants-in-Aid made fifty awards totaling \$23,675 for work during the academic year 1935-36. As in previous years, these awards were for the purpose of aiding mature scholars in the completion of research projects already well under way. The sum of \$25,000 which will become available on April 1, 1936, for grants-in-aid of research to be carried on during 1936-37 terminates the four-year appropriation to the Council for this purpose. If these awards are to be continued without interruption new funds must be secured before the summer of 1936. The Council has repeatedly shown itself more attached to grants-in-aid than almost any other item of its program, but it faces great difficulty in securing funds for this purpose.

WILLIAM A. BERRIDGE, *Chairman*  
SEYMOUR L. ANDREW  
EDWIN B. WILSON

**REPORT OF THE REPRESENTATIVES ON THE COMMITTEE TO ADVISE THE  
NEW YORK STATE DEPARTMENT OF SOCIAL WELFARE**

The Committee to Advise the New York State Department of Social Welfare was appointed in 1932 by the Committee on Social Statistics of the Social

Science Research Council, to assist the department during a period of three years in attempting to establish a program for comprehensive statistics of welfare administration in New York State. With the expiration of the specified period the committee has tendered its resignation and has suggested that its functions be transferred to a new committee responsible directly to the State Department of Social Welfare. This suggestion has already been followed. During the past two years the committee has been composed of Emma A. Winslow of the U. S. Children's Bureau, Frank Bane of the American Public Welfare Association, Neva R. Deardorff of the Welfare Council of New York City, Luther Fry of the University of Rochester, William Mosher of Syracuse University, and Horatio M. Pollock and Ralph G. Hurlin, representing this Association. During the three year period the Spelman Fund of New York has made an annual grant to the Department for this project, and during the past year through this means the services of Helen R. Jeter have been available for the immediate direction of the work. The work has been carried on in the Division of Statistics of the Department of Social Welfare, of which David M. Schneider is Director.

While the accomplishment of the three year period falls considerably short of the original expectation, a large amount of careful study has been given to the problem of welfare statistics for the state and carefully devised plans for statistics have now been adopted by the Department for five major fields of welfare administration. The plans have been matured by subcommittees, each including in its membership administrative officers of the State Department, statisticians, and experts in the field of work in question. The fields are: foster care of children, including both child caring agencies and institutions for children; mothers' allowances; private institutional care of the aged; hospital in-patient service; and hospital out-patient service or dispensaries and clinics.

For each of these five fields a statistical handbook has been published during the past year, presenting the report forms to be used, definition and explanation of all items appearing on the forms, the reasons for requiring each item, and complete outlines of tables to be compiled from the reports. The details of the reporting systems vary from field to field. For all fields annual reports are required; in the fields of foster care of children, mothers' aid and private homes for the aged, monthly reports of volume of service are also required; and in the field of foster care of children a report is required concerning each child admitted to care. The plans for annual financial reports are in accord with the principles of modern accounting and represent, it is believed, a particularly noteworthy contribution. These statistical plans have been developed primarily for use in New York State in accordance with the existing legislation in that state. They have, however, been formulated to agree with other existing schemes of welfare statistics and with slight modification in some particulars can be used in other states.

The purpose underlying handbooks is to produce for the respective fields reliable periodic statistics concerning the total volume and cost of work carried on in the state which can be used in planning welfare administration and legislation. The Department in requiring the submission of reports in

these five fields has agreed that the data will be compiled and published in detail. The plan in the field of foster care of children was put into effect on January 1, 1935, and that for mothers' aid during the year, so that the first annual reports under the new plans in these fields will be available during the coming year. In the other three fields the new plans become effective on January 1, 1936.

The New York State Department of Social Welfare has had in effect for several years an adequate plan for statistics of old age relief and the reporting of state-wide statistics of public unemployment relief has been maintained since 1933 in connection with the State administration of unemployment relief. In closing this report it is pertinent to remark that no state in this country devotes more attention to the compilation of statistics of welfare administration than does New York. Even in this state, however, the provision for collection and analysis of welfare statistics lags very far behind that for education, health, and labor statistics. There is still great necessity for attention by this Association to the need for development of welfare statistics in the several states and on the part of the federal government. The fate of the promising program which has been set in operation in New York State will depend largely upon the ability of the State Department of Social Welfare to command sufficient funds to carry out the program.

HORATIO M. POLLOCK  
RALPH G. HURLIN

REPORT OF THE JOINT COMMITTEE ON THE DEVELOPMENT OF  
STATISTICAL APPLICATIONS IN ENGINEERING  
AND MANUFACTURING

The work of the committee this year, as in the previous one, has been largely that of consulting with men from various industries on special problems. Such requests have come from several new as well as old sources. Members of the committee have been of assistance in such typical problems as: (a) trying to set up criteria for determining how much data should be taken in specific cases; (b) choosing efficient sampling plans; (c) choosing efficient ways of presenting data; (d) writing inspection specifications; (e) establishing adequate criteria for quality control; and (f) interpreting the results of statistical analyses of data. Other services rendered have been the review of confidential memoranda from men in several industries involving statistical problems and the furnishing of references to published work in the theory and practice of statistical techniques. The committee has also continued to function in the capacity of a coördinating agency for similar activities carried on by other committees or institutions both here and abroad.

W. A. SHEWHART, *Chairman*

## REVIEWS

*Prices in the Trade Cycles*, by Gerhard Tintner. Vienna: Julius Springer. Published in Coöperation with the London School of Economics and Political Science by the Austrian Institute for Trade Cycle Research. (Obtainable from G. E. Stechert & Co., New York City.) 1935. xii, 203 pp.

Dr. Tintner has done an important job. After applying an interesting technique to 168 price series from various countries to eliminate random, seasonal, and trend movements, he has subjected the residual cyclical movements to detailed analysis. The measures he has compiled will command the attention of every worker in the field of business cycles. But since these measures do not lend themselves to easy summary, the discussion here will be devoted primarily to a sketch of the data and the statistical technique used by him.

The price data at Dr. Tintner's disposal were the richest heretofore analyzed. Besides using 98 monthly American price series analyzed by Frederick C. Mills in *The Behavior of Prices*, he has collected 77 German series, 71 English series, and 5 from Austria, 12 from Holland, and 3 from Russia. The price quotations are monthly or quarterly and cover varying portions of the period from 1845 to 1914, predominantly 1880 (or 1890) to 1914. With the exception of a few series of interest rates and freight rates, the prices refer to commodities, chiefly in wholesale markets. Restriction to the countries and goods named was forced by the paucity of data and the expense of a laborious analysis. Stopping short at 1914, however, is defended on other grounds. As stated by Professor Morgenstern in his foreword, "the disturbance caused by the war has been so great and so lasting that one may question altogether the fact of a regular cycle after 1914." Whether or not we quarrel with this, the value of any conclusions derived from the restricted period cannot be denied. Economic analysis is difficult enough, and if the number of factors to be considered can be reduced, so much the better. On the other hand, extending the period of examination to include the years following 1914 would have considerably increased the size of the sample of business cycles, and thereby the reliability of the results. The dilemma is a real one, and one should not cavil at the alternative selected.

Dr. Tintner removes the random fluctuations by assuming, first, that they are the results of casual factors (such as small chance elements or episodic events) affecting generally but one term of the series; and second, that the remaining (economic) fluctuations are expressible as continuous functions of time. These assumptions make possible the application of Professor Oskar Anderson's technique (cf. *Die Korrelationsrechnung in der Konjunkturforschung*). The actual process of elimination involves the use of moving averages of varying periods. If either of the assumptions is unpalatable (the behavior of monopoloid prices, which move in step-wise fashion, discontinuously, comes to mind) Dr. Tintner's results need not be rejected, since

the period of most of the moving averages he employs is only three months. (Of 168 series, 111 are smoothed by 3-month moving averages and 33 by 5-month moving averages.)

The economic fluctuations remaining after the smoothing of the series are assumed to be the arithmetic sum of seasonal, trend, and cyclical movements. The seasonal fluctuations are removed simply by a twelve-month moving average. (An attempt is later made by Tintner to estimate the concomitant loss of cyclical amplitude on the supposition that the cyclical movement is purely sinusoidal.) Assuming that the cyclical movements are those remaining fluctuations varying in duration between one year and twelve years (p. 19), Dr. Tintner then applies still another moving average to eliminate them and thus to obtain the trend. This moving average is of varying period, based (roughly speaking) on the number of months between corresponding phases of two contiguous cycles, and centered at the middle month of the period so chosen. The cyclical values are then expressed as percentages of the corresponding trend values. The characteristics of the cyclical movements thus finally obtained are reduced to various measures, some of which are already familiar to readers of Mills' *Behavior of Prices*.

In order to determine relative turning points and other relations among different price series, Dr. Tintner builds up a series of general business cycle reference dates on the basis of Willard L. Thorp's *Business Annals*. Unlike the National Bureau technique, however, in which the reference cycles of each country are different, Dr. Tintner's method combines the reference dates of the six countries considered. In his scheme a cycle is shown even when only one of the countries shows evidence of a business cycle. Since the dates so combined do not quite correctly fit the business fluctuations of any country, there is some danger that individual price cycles will be identified with the wrong reference cycle if their turning points greatly lead or lag behind the changes in general business. More serious, however, may be the treatment thus accorded special cycles in individual price series. Special cycles—fluctuations with a period greater than one year, yet not identifiable with cycles in domestic general business—may reflect business changes in other countries. This may be especially true of prices of commodities entering into international trade. On the other hand, they may be unrelated to general changes in either domestic or foreign business. To set up an international cycle scheme as Tintner does is to assume that all special cycles happening to coincide even very roughly with general fluctuations elsewhere are part of those broad movements. This assumption (that it is an assumption is pointed out by Dr. Tintner on p. 49) is not easily accepted. To the extent that the special cycles are not reflections of movements in general business somewhere in the international economy, average turning points will be in error, and uniformities within countries—which might otherwise be visible—will be obscured. A more satisfactory procedure might have been a separate treatment of each country, followed by an examination of international relationships as a possible explanation of special cycles.

Although Dr. Tintner often sets a good example in expressing distrust of



averages based on few items or on items widely divergent, it is to be regretted that measures of dispersion were not computed and presented in detail. For example, the statement is made (p. 61) that the cyclical movement of the interest rate in England leads slightly (by one month) changes in the interest rate in Germany, and that this may be explained by the position of England as the leading capital market. But reference to the appendix (Table V, col. 2) shows the following differences (in months) between turning points in English and German interest rates, in the cycles for which comparison is possible: 0, +1, +17, -3, -2, 0, -10, +2, -14, 0, +4, +4, +1, +3, +3. The median (the figure Tintner quotes) is indeed +1, but the scatter about the median seems too large to be ignored.

The only detailed figures given for each price series are the dates of the turning points. If all averages were supported by the detailed figures the reader could in every case make use of Dr. Tintner's materials to draw his own conclusions. The omission of these measures decreases somewhat the value of the work, especially if the common reference scheme discussed above be rejected. (Even if the reference cycles selected by Dr. Tintner be considered unsatisfactory, a major part of the study remains unaffected, of course.)

The use made of various principles of classification and the discussion of international price relations may only be mentioned. The economic implications inherent in various statistical methods are brought out clearly, and economists who wish to use these methods will gain from a perusal of Dr. Tintner's acute and stimulating discussion.

SOLOMON FABRICANT

National Bureau of Economic Research

*The New Deal and Foreign Trade*, by Alonzo E. Taylor. New York: The Macmillan Company. 1935. xii, 301 pp. \$3.00.

It is always difficult to assign to a book dealing with social problems a brief title which exactly defines the scope of the book. In this case the title is at the same time too wide and too narrow. It is too wide in that the book is concerned only with foreign trade policies in so far as they constitute a part of the Government's policy toward agriculture. It is too narrow in that a substantial part of the book is devoted to a consideration of American agriculture and the problem of contracting acreage—a problem which is obviously one of domestic significance quite aside from its international implications. It is, in short, a study of the maladjustment of American agricultural production to the demand, both foreign and domestic.

The author justifies this identification of the agricultural problem and the foreign trade problem by the observation that "The Secretary of Agriculture, not the Secretary of State, for the time being at least, seems to be the spearhead of the foreign trade policy of the New Deal." The policies of the Secretary of Agriculture (and, by inference, of the Administration) are taken to be those embodied chiefly in two statements by Mr. Wallace, *America Must*

*Choose*, a pamphlet prepared for the Foreign Policy Association, and "American Agriculture and World Markets," in the issue of *Foreign Affairs* for January, 1934, and, to some extent, in Mr. Wallace's *New Frontiers*.

The preface asserts that the book is openly but respectfully critical, and the book, as a whole, adheres to this standard. It does not resort to the devices so common to political controversy of attempting to score a point. It is a thorough and well reasoned statement of the case for the opposition. Much more emphasis is placed upon the weaknesses and alleged fallacies of the New Deal policies than upon a constructive alternative policy, though the latter is by no means completely neglected. Concerning this emphasis, the author remarks: "In the social as well as in the physical sciences, it is proper to criticize what is regarded as error without putting an asserted truth in the place of the error criticized," and "The right and duty of criticism are not to be abridged by the inability of the critic to prepare and offer an alternative. But in fact, for the problem of foreign trade, the alternative exists in historical experiences since the industrial revolution."

The views of the Secretary of Agriculture are fairly familiar to all: American agriculture was and is adjusted to production for the foreign as well as for the domestic market. A surplus unsalable at "decent prices" has arisen partly through an increased efficiency of agriculture, partly through a decline in the domestic demand, but especially through the sharp reduction in the foreign market. This reduced foreign demand has come from a number of causes but to a substantial degree has resulted from the unwillingness of this country to accept non-agricultural goods in exchange for agricultural exports. Three policies are available from which "America must choose": (1) the policy of internationalism under which we would more freely accept imports (presumably of manufactured goods) in exchange for exports (presumably of agricultural goods) to an amount sufficient to remove the agricultural surplus; or (2) the policy of nationalism under which we would retain or perhaps raise further our restrictions upon imports and thus indirectly upon exports. Under this policy we must be prepared to retire from production from 40 million acres of good land to 100 million of poor land; or (3) there is the middle course which is to meet the problem partly by increasing exports through increasing imports and partly by contraction of acreage, specifically by about 25 million acres of good land or 50 million of poor land. Mr. Wallace favors the middle course but assures us that the middle course involves planning as surely as would the policy of nationalism. Involved in this planning is apparently the decision on what foreign products we should accept and the negotiation of bilateral trade agreements with the several countries of the world.

Mr. Taylor raises no serious objection to the program of contraction of acreage, either in principle or in details. As to the foreign part of the policy, however, he generally disagrees. He believes that the selection, on any equitable basis, of urban industries to be exposed to the full force of foreign competition is an impossible task, partly because we lack the factual material needed for such decisions and partly because we do not have the national

discipline required to make any such planned program acceptable. Also, he objects to the emphasis upon bilateral trade, again because of the practical difficulties of devising agreements by which our agricultural exports will be taken in exchange for specified goods from the foreign countries. But also there is a general objection to the channelizing of trade and the neglect of multangular trade, which was until recently such a prominent part of world commerce. On this point in particular, Mr. Wallace's policy of "internationalism" will be rejected by those economists who have always considered themselves as internationalists in the sense that they favor the extension of international trade with the least practicable degree of interference. His idea is that we conclude "loans and trade deals with foreign countries as nearly as possible on a bilateral basis and not get involved in the confusing complexities of triangular and polyangular trade with which the economists like to mess up our minds." One must sympathize with the author's rejoinder that it is not the economists who have created the complexity but the events of a century of active world trade between the Napoleonic wars and the World War.

It is obviously not the duty of a reviewer to attempt a judgment between the opposing views. It may be remarked, however, concerning both that there is little faith in the force of the principle of comparative cost, and, furthermore, that both adopt a sort of lump of work doctrine in their views that to increase the imports of manufactured goods will decrease the market for manufactured goods. For example, Taylor says, "To plan an increase of non-agricultural imports equivalent in value to a billion dollars *and sequentially to curtail the operations of urban industries to the extent of a billion dollars.*"

... Mr. Wallace likewise seems to imply that he favors a policy under which a fair balance between urban industries and agriculture is to be established and that such a policy would have to sacrifice some urban industries, and he does not make clear, if indeed he believes, that other urban industries may be more than correspondingly stimulated.

But there is no reason for assuming that urban industries as a whole would suffer by thus "letting down the bars." Trade obstructions are not simply a protection to manufacturing at the expense of agriculture. They are equally a protection to ineffective manufacturing at the expense of effective manufacturing. Hence, a removal of these protections might very well lead to a stimulus to urban industry as a whole. The reduction or removal of protection would not reduce our exports of manufactured goods, for the exporting industries are obviously gaining no help from trade obstructions. These same industries would gain from such removal of barriers in two ways: (1) from the fact that consumers could buy the products of other manufacturing industries more cheaply and would thus have more to spend on the products of the effective industries; and (2) from the increased purchasing power of agricultural consumers. This, of course, is merely a statement of the old-fashioned view that unhampered trade leads to production at lower costs and to a growing volume of production.

It appears that both these writers have slipped into the depression attitude

that there is a certain amount of production possible and if one industry gets more than its share another will get less. Furthermore, it is interesting to observe that neither Mr. Taylor nor Mr. Wallace gives more than a passing nod to the consumer. Of course, it is true that producers are, by and large, also the consumers, but I believe that much fallacious reasoning has been encouraged in recent years by attacking the problems of the depression almost exclusively from the point of view of the producer. That point of view leads to a search for means by which workers can raise wages, farmers get better prices, and manufacturers in protected industries can maintain their prices. There is, I believe, more hope in policies which look to reducing costs and prices—surely more from the point of view of consumers, which is the most important test, and probably more from the point of view of producers in volume of business and, eventually, in profits.

It is hardly necessary to add that for scope of the questions attacked and for thoughtfulness of treatment, both the positive case by Mr. Wallace and the criticism by Mr. Taylor will amply repay careful reading by students of the social sciences. The two together constitute a discussion of a vital matter of statecraft on a higher plane than has been customary in the treatment of such questions in this country.

C. E. GRIFFIN

University of Michigan

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*Machinery, Employment and Purchasing Power*, by National Industrial Conference Board, Inc. New York: N.I.C.B. 1935. xiii, 103 pp. \$2.00.

The major objective of the authors is to prove the fallacy of the widely prevalent view that the use of machinery in production tends to a permanent increase in unemployment. On the whole, the evidence presented is not new but consists of a skillful marshaling and comparison of the available estimates of unemployment, occupational shifts, production, mechanization, and income.

Briefly, the conclusions reached are (1) that except in depressions the larger part of unemployment is due to sickness, injury, old age, labor disputes, and seasonal fluctuations; and that there is little or no evidence to indicate that the machine aggravates either seasonal or cyclical unemployment; (2) during the period of rapid mechanization the percentage of the population classified as gainful workers has actually increased rather than declined, and there is no clear evidence of an upward trend in the rate of unemployment among the working population; and (3) since the turn of the century the productivity and the real income of the worker have increased substantially despite a 10 to 15 per cent shortening of the average working week.

These results, it is urged, are not surprising, because in large part machines have been utilized to manufacture new commodities or to improve the quality of old products, and, even when used to increase the quantity of old products, the result has often been an increase in the total output at a lower price rather than a sharp reduction in the labor force.

The brevity of treatment leads in a few instances to statements which are ambiguous or inadequately supported by the evidence presented. How, for example, can one reconcile the estimates that from 1899 to 1929 weekly hours of labor in manufacturing declined 14.8 per cent, and output per wage earner rose 68 per cent, but output per man-hour rose only 60 per cent (page 85)? With a shorter work week it would appear that output per wage earner must have risen less than output per hour. But the observed discrepancies do not impair the main argument in essential respects, and not much elaboration of details can be expected in so short a treatise.

Probably few readers will question the conclusion that in the long run the machine has increased rather than decreased employment, except to point out that mechanization means an increasing roundaboutness of production and thus aggravates the elements of uncertainty and misjudgment which contribute to cyclical fluctuations. Moreover, the concentration of attention on the long-run effects may be considered to be merely tilting at windmills. Of more practical concern are the immediate hardships, perhaps limited in time but nevertheless real, which come to particular individuals or groups from obsolescence of their skill or from complete elimination of their jobs by rapid mechanization. This book does not provide an adequate analysis of the short-time effects of mechanization but is a useful addition to the literature of the long-run effects.

HARRY JEROME

University of Wisconsin

*The Formation of Capital*, by Harold G. Moulton. Washington, D. C.: The Brookings Institution. 1935. xi, 201 pp. \$2.50.

*The Formation of Capital* is the third of a series of studies which have appeared in the past year or two under the supervision of the Brookings Institution. Immediately preceding have been *America's Capacity to Consume* and *America's Capacity to Produce*. Following it is to be a general volume consolidating the ideas set forth in the three preceding inquiries. These four volumes are included in a study of the "Distribution of Wealth and Income in Relation to Economic Progress" and have been carried out with funds granted by the Falk Foundation of Pittsburgh.

Here we have a study of a most important topic—the relation of economic society to its financial organization, which is apparently presented coördinately with analyses of production and consumption. The implication, plainly, is that credit organization and distribution is to be treated as of an importance similar to the study of the producing and consuming arrangements of society. It is not certain that the author intended to suggest as much, or even to imply that the financial mechanism is as independent of, and as detached from, the other branches of economic organization as is true of the arrangements or institutions discussed in the other volumes. At any rate, *The Formation of Capital* is, in fact, chiefly a specialized study of banking and of bank credit methods, to which has been assigned a title evi-

dently intended to direct the attention of the reader to the connection between manufacturing and business on the one hand and banking and investment on the other. It is a province of study that is now much in the public eye and is already the field within which a very large literature is being steadily developed.

As the third in a series of connected monographs, Mr. Moulton's book thus represents an important conception—the thought that money, banking, and credit, are no longer to be dealt with as independent technicalities, but as phases of the great processes of production, distribution, and consumption of income. Unhappily, the "integration" of the volume does not fully bear out the expectation thus formed nor does the technique of it satisfy the standard of accuracy and reliability which the student in this field must exact. The two preceding monographs were themselves statistically sketchy and inadequate, and their apparent incompleteness and immaturity of judgment—letting alone statistical or other errors of fact—tend to invalidate much of the author's treatment and to make its conclusions appear at best suggestive rather than informative. Generally speaking, Mr. Moulton endeavors to form a theory of credit which will assume a place as a phase of the theory of production and investment. In so doing, either lack of data or lapses of judgment have led him to make a good many extreme statements. His general conclusion is that "if new capital is to be created there must be an increasing flow of funds through consumption channels as well as through savings channels." In other words, he feels that the growth of capital is possible only if goods are regularly sold and consumed. Apropos of this, we may recall that particular one of Mill's five fundamental propositions respecting capital which states that everything that is produced is consumed, both what is saved and what is spent, and the former quite as rapidly as the latter. To take it at its face value, Mr. Moulton appears to have developed in his statement a grasp of the already obvious and long admitted truth. His use of his "discovery," however, appears when he makes the statement that "the facts" (details not given) show incontrovertibly that new capital is constructed on a substantial scale when consumption is expanding rather than when it is contracting; whereas, he says that when both consumption and capital goods are being increased, there is an expanding flow of funds through both consumption and investment channels. What is meant here by the vague word "funds" is not altogether clear though the general thought is simple. In short, the main conclusions of *The Formation of Capital* are either obvious or in doubt, and the impression left by the book is that of a hasty attempt to prove something without success in indicating exactly what conclusion has been reached.

It is, after all, largely as an offshoot of this credit discussion that *The Formation of Capital* is interesting and worth while. A very large part of the book is devoted to the analysis of bank credit and the reasons for dealing with it as we do, particularly the question of how far an increase in bank credit means an increase in price. On this point, the author arrives at the conclusion that the professional type of analysis ignores the relation of con-

sumptive demand to the formation of capital and that the close connection usually assumed between growth of bank credit and increase of prices does not exist. This appears to have been a conclusion reached some time ago by the author in articles published by him in the *Journal of Political Economy* and backed up (after the fact) by references to various recent British writers on prices and cyclical changes. The author appears to be, on the whole, "on the fence" as between the so-called "inflationists" and their opponents. There is suggestive material in the chapters referred to but he is apparently handicapped to some extent by what he had done sixteen or seventeen years ago, when this discussion was still at a very much earlier stage. From what has been said, it might appear that the volume was non-partisan in treatment or, at least, that it did not commit itself to any given school. Such freedom from dogmatism, however, cannot be claimed by *The Formation of Capital*. The repeated statements that "We have already demonstrated . . .," or, "the facts incontrovertibly show . . .," or, "there can be no doubt that . . .,"—all indicate that the book has been written in anything but a non-dogmatic frame of mind. This tone tends to impair the usefulness of the work from a scientific standpoint and might, to the great advantage of the monograph, have been modified.

On the whole *The Formation of Capital* is more interesting for what it suggests than for what it contains. It is what the Germans call a *tendenzschrift*—it indicates the drift of money and banking discussion and is thus interesting, although it reaches very doubtful conclusions and leaves the reader about as wise as he was before he read it.

H. PARKER WILLIS

Columbia University

*The Great Depression*, by Lionel Robbins. New York: The Macmillan Company. 1934. xiv, 238 pp. \$3.00.

In this noteworthy study Professor Robbins, of the University of London, examines the causes of the world depression and traces the development of economic and political events from 1914 through 1933. His analysis of the depression and of measures necessary for recovery is based upon an abstract theory of economic equilibrium in which salient factors are free competitive markets in the buying and selling of goods and with respect to the factors of production, relative freedom of international trade, and the unhindered operation of the pre-War gold standard. Any restriction which keeps prices from falling to the cost of the marginal producer or which keeps the international flow of gold from giving rise to offsetting changes in national price levels, he regards as elements of disequilibrium.

What were the causes of the depression? Primarily, "monetary mismanagement and State intervention operating in a *milieu* in which the essential strength of capitalism had already been sapped by war and by policy." The general causes then were the World War and the subsequent economic maladjustments which gave rise particularly to economic nationalism. By

monetary mismanagement Professor Robbins refers primarily to the mistakes of the central banks: in England, the mistake in stabilizing the pound at too high a parity; in the United States, the mistake in lowering rediscount rates in 1927 in order to assist Great Britain in remaining on the gold standard. With the pound stabilized at too high a value there should have been a considerable decrease in credit and deflation in costs. By State intervention, the author has in mind assistance given to monopoly organizations both among producers and among workers. Monetary mismanagement in his opinion is primarily responsible for the general inflationary movement which led up to the crisis of 1929. (In this connection, Professor Robbins develops the outline of what he calls a "possible Trade Cycle.") Expansion in the producers' goods industries was stimulated by abnormally low interest rates, which were the result of banking policy and not of increased savings. New monetary claims resulting from increased activity in the heavy industries after a time filtered down to the ultimate recipient, but there was no increase in the proportion of income saved. The demand for finished consumers' goods, therefore, was strengthened, profits in the industries making these goods rose, and the rate of interest also began to rise. Other costs followed and it soon became apparent that the anticipation of large funds at low rates of interest for investment in the producers' goods industries was illusory. The investment in lines of industry most affected by the rate of interest—building and construction—became unprofitable. The demand for capital goods fell off, and a depression began in the heavy industries. The major financial mistake, then, was the lowering of interest rates unaccompanied by an insufficient increase in the volume of savings.

Why was the depression so severe and so long? Professor Robbins indicates that this was a result both of pre-depression influences and of mistakes which arose after the depression began. Among the former were War dislocations which had not been removed by the end of the 1920's, notably the capital shortage in Germany and in Central Europe and the resulting tremendous variations in the rate of interest among countries; the fact that the decrease in agricultural prices resulting from technical improvements coincided in part with the industrial depression; inelasticities resulting from policy, in particular the monopolistic action of trade associations and cartels aided by tariffs and general State approval and similar action by trade unions also assisted by State measures, especially unemployment insurance; and a major inflation, disguised by a constant price level, which greatly overstimulated the capital-goods industries and led up to an unusually severe depression in those industries. The major errors committed after the beginning of the depression are held to be the adoption of protective tariffs as a cure for declining business and other State efforts to save a business situation which was fundamentally unsound, especially in the United States. Here the author refers to the efforts to hold up purchasing power and wages and the assistance given to weakened firms, without respect to whether they were essentially unsound or not. Specifically, he mentions the action of the Federal Reserve Board in initiating its open market policy in 1930 and in arresting the neces-



sary process of deflation and postponing the liquidation of bad business situations,<sup>1</sup> and, further, the subsequent propping up of unsound positions by the Federal Farm Board, by the Reconstruction Finance Corporation, and similar efforts.

What are the prerequisites for recovery? The first essential is the return of business confidence aided by the immediate stabilization of exchange rates and the final return to the pre-War gold standard. The second is the freeing of international trade by the abolition of quotas and by a general decrease in tariffs. The third essential is the restoration of the adaptability of the economic system by the elimination of all kinds of inflexibilities. Wages and prices must be allowed to rise and fall in relation to relative demand and must not be isolated from the influences of the market by the power of cartels and labor organizations. Professor Robbins holds that flexibility would be restored if the State withdrew all assistance. "So far in the history of the world cartels and labor organizations exercising strong monopolistic influence have not shown themselves to be capable of survival save as a result of direct or indirect assistance from States." A greater flexibility of wage rates would, in the author's opinion, materially assist in reducing unemployment.

Such, in broad outline, are the major conclusions of an economic study which is unusually lucid and logically organized. Among contemporary British and American economists, Professor Robbins' exposition is of the best. His meaning is clear and his theoretical analysis stimulating.

Two critical observations may be advanced: first, Professor Robbins over-emphasizes the possibility of the general reestablishment of a free market, and, second, he underestimates or neglects sources of instability other than those of monetary mismanagement and State intervention. To hold that if the State did nothing to bolster up monopoly (in particular if tariffs were drastically reduced), monopoly as a source of inflexibility would be eliminated is to overlook the existence of international control of raw materials, the allocation of markets by international sales organizations, the opportunity in large countries for monopoly control in interior markets protected by transportation costs from foreign competition, the additional opportunity for monopoly control where products must be produced locally, the exceedingly small number of competitors in some industries, the possibility of price control where the relative level of costs of an industry under monopoly or partial monopoly control are considerably lower than that of foreign competitors, and other factors which facilitate the growth of monopoly. Action more drastic than the withdrawal of State intervention and the downward revision of the tariffs would be necessary to create a free competitive market in all products. Indeed, actual Government interference may be necessary to preserve competition in those cases where there is collusion among competitors with respect to price or by regulation to approximate the results of

<sup>1</sup> Professor Robbins is very pessimistic about the outlook for democratic government unless elasticity is restored to the economic system; he holds that the postponement of deflation in Germany, particularly with respect to the writing off of bad debts, provided the immediate occasion for the Nazi Revolution.

competitive conditions in instances of duopoly or of a relatively small number of producers.

Professor Robbins holds that the removal of State unemployment insurance and other indirect State supports of trade unions would restore the elasticity of wages. Such action might bring home the relationship between the level of wage rates and relative unemployment to those unions where the demand for the labor of their members is elastic, but the author overlooks the fact that the demand for labor is probably relatively inelastic in some important occupations and that public feeling about "just" or "fair" wages has tended to augment the inflexibility of wage rates. The author's remarks apply with less force to the United States than to England because of the lack of unemployment insurance in this country. Yet despite the absence of such assistance from the State, trade unions have felt little pressure to reduce rates in order to decrease unemployment; the unions in this country are mainly craft unions with little feeling of responsibility for the effect which high rates for skilled labor may have in decreasing the total demand for unskilled labor. Inelasticity in wage rates in the United States may in part result from Government pressure but is more likely to follow from the widespread conviction that high wages are necessary for the healthful operation of the economic system and, in those instances in which wage rates are the most rigid, from trade union strength. Witness the rigidity of rates in the buildings trades.

To point only to monetary mismanagement and State interference as sources of instability and inflexibility in the economic system is to overlook the influences of reparations, war debts, changes in the debtor-creditor positions of the United States and Germany, the spread of industrialism over the world since the War, the increasing proportion of total costs which are fixed and invariable, the slowing up of population growth, and the consequent slowing up of the growth in demand for agricultural products. The marvelous adaptability of the capitalistic system which the author refers to and which he feels would be restored if central banks and the State generally would refrain from interfering with the operation of the economic system may have been very real during a period of expansion but may be seriously impaired during a period of marked retardation in the rate of industrial growth and of impending decreases in population.

GLENN E. McLAUGHLIN

University of Pittsburgh

*The Role of Money*, by Frederick Soddy. New York: Harcourt, Brace and Company. 1935. x, 212 pp. \$2.00.

This book is a curious mixture of scientific investigation, moral reform, unproved premises, and incomplete analyses. Its basic theme is that all economic ills are directly traceable to our credit system, and that when this has been improved, according to the author's suggestion, all will be well with the economic system.

In elaborating his thesis, Soddy begins with a vigorous denunciation of traditional economic theory as belonging to a past age of scarcity. Modern science has ushered in a new age of plenty which demands a new economic theory. This body of theory is developing "from the application of the principles of the sciences of the material world, physics and chemistry, to economics and sociology." This new body of doctrine is *Ergosophy*, "the wisdom of work, energy, or power, in the purely physical sense."

There is one insuperable obstacle which impedes the flow of wealth from producer to consumer made possible by modern science, the money system. Its fundamental defect is that it permits wealth to be confused with debt. To prove this thesis he restates his theory of money and virtual wealth. Money should be looked at, not as it has been traditionally, that is, as a means of purchasing, but rather from the point of view of the goods and services given up to obtain the money. "Money now is the nothing you get for something before you can get anything." The owner of money is the creditor, and the issuer of money is the debtor. The chief issuer of money in our credit society is the banking system, so it is upon the bankers that the full responsibility for economic ills must be placed. Bankers, by creating money, are getting something for nothing. This power should be transferred from banks to the government. Then, as loans are repaid, the government should put the money back into circulation by buying with it securities representing the national debt, the securities then being destroyed. Moreover, money should be issued on a new basis, not to producers at the beginning of production, when it causes great fluctuations in business, but to consumers in relief of taxation, after the new production has matured.

The one good point in this book is the author's constant emphasis on the instability of our credit system. Otherwise, it is an illustration of a most unscientific and incomplete attempt at investigation without proper consideration of the pioneering work of other scholars, whose efforts he so lightly dismisses.

JAMES F. CUSICK

Dartmouth College

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*French Import Quotas*, A New Instrument of Commercial Policy, by F. A. Haight. London: P. S. King & Son, Ltd. 1935. xi, 125 pp. 7s. 6d.

Opposed in principle to trade restrictions, Mr. Haight has undertaken to study the French import quota system as typical of quota systems which, he believes, have assumed "a position of permanence in the new commercial policy of many nations." In this volume, the evolution of the quota system in France from the emergency measures of 1931 to protect agriculture and industry from the deflationary influence of falling prices to its development as a bargaining instrument is traced; the two types of quotas, unilateral and bilateral, are differentiated and appraised; the techniques and difficulties of administration are discussed; and their use in the new bilateral trade agreements is described. In two other chapters, there is an attempt to analyze

by means of the presentation of statistical material the effects of the quotas on imports, direction of trade, the exporting industries, the trade balance, and the French price level. Although these chapters contain assembled material of importance bearing on the economic and financial dilemma of France, it has been a well-nigh impossible task to separate out the specific effect of quotas as distinguished from clearing agreements, the equalization tax, higher tariffs and other trade barriers, not to mention deterrents to foreign trade in the world at large.

Import quotas, Mr. Haight concludes in a summary chapter, are an "extraordinary measure" undertaken by France to correct a dangerous unbalance of trade at a time when the usual means of high tariffs, deflation, or devaluation were insufficient, impractical, or politically impossible. Although he would have preferred a program involving the denunciation of the treaties in which tariffs were consolidated, and the use of tariffs which "do not destroy the price system," he does admit that "quotas afford much better protection than do tariffs against a flood of goods from countries with depreciating currencies." In another paragraph, this opponent of the principle of reciprocity and of national self-sufficiency states that the planning of foreign trade, a corollary of the new philosophy of autarchy, "is a logical development of the quota system." This statement would seem to confuse the technique with the policy it has been made to serve, although it is patent that the success of such a system is dependent upon scientific planning. During the past four years import quotas have been commandered by some 26 countries to protect individual currencies and national price levels or to promote the aims of economic nationalism. Whether this defense mechanism and bargaining weapon will become an orthodox instrument of future trade policy will depend both upon the success of the present experiments and upon the *set* of the trend, toward or away from the principles of liberalism.

The book includes a series of thirteen tables containing price and foreign trade figures, a tabulation of the French quotas, and two graphs which illustrate the effect of the quota system on the internal price level. One of the first in the field, this study represents a significant contribution to the literature on foreign trade.

ETHEL B. DIETRICH

Mount Holyoke College

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*Wheat Studies of the Food Research Institute* (Stanford University).

"Decline in Wheat-Flour Export During the Depression," Vol. XI, No. 2, October 1934, pp. 39 to 73. \$.75.

"Per Capita Wheat Consumption in Western Europe," Vol. XI, No. 7, March 1935, pp. 255 to 305. \$1.00.

"Spreads between Wheat Prices in England," Vol. XI, No. 8, April 1935, pp. 307 to 325. \$.50.

"World Wheat Survey and Outlook, May 1935," Vol. XI, No. 9, May 1935, pp. 327 to 358. \$.50.

"International Wheat Policy and Planning," Vol. XI, No. 10, June 1935, pp. 359 to 404. \$.75.

"World Wheat Prices, Canadian-Argentine Spreads, and the Ottawa Agreement," Vol. XII, No. 2, October 1935, pp. 35 to 56. \$.50.

Throughout the depression, students of the wheat situation have devoted major attention to estimating and explaining the decline in the international movement of wheat. In view of this fact, it seems most fitting that a special study should be devoted to the parallel situation in respect of flour. The wisdom of such procedure becomes still more clear when evidence is supplied to show that the decline in international trade has been decidedly more marked in flour than in wheat. The most interesting and valuable feature of the study devoted to this subject, however, is the attempt at listing and evaluating the various factors contributing to flour-export decline. Although the analysis is confined largely to the United States export situation, most of the factors cited apply universally, if with varying degrees of intensity. Indeed the special consideration of United States exports has permitted inclusion of one factor which the author rightly considers to be of prime significance. We refer to the claim that the chief reason for the drastic fall in United States flour exports has been the existence of a higher wheat price in Chicago than in the wheat and flour importing countries. It is pointed out that the influence of the wheat price on flour exports is specially pronounced in a country such as the United States in which millers have developed the practice of hedging their operations. Other factors held responsible for the greater decline of flour relative to wheat exports include the tendency to discriminate in favor of wheat as against flour in the matter of freight rates, tariff rates, and other import restrictions. A most important suggestion is that, from the political point of view, the special regulations restricting the ways in which bakers in importing countries could use imported flour are likely to become permanent and to constitute the chief barrier to the recovery of the international flour trade.

The study devoted to per capita wheat consumption undertakes to investigate trends in respect of wheat consumption in 13 Western European countries during the past 50 years. Special emphasis is placed on the necessity of distinguishing clearly between the different wheat uses when attempting estimates of total utilization. Total consumption must be subdivided into human consumption and livestock consumption, and total utilization must also include wheat used for seed. A major disclosure is the wide variation among countries in the manner in which total consumption is subdivided. Non-food uses are very important in some countries, but not in others; and non-food uses have greatly expanded since before the war in some countries but not in others. A most significant, if somewhat tentative, deduction is drawn from the data covering food consumption of wheat. It is that there is little evidence to substantiate the common assumption that wheat tends to displace rye completely in national diets. On the contrary, the view is here advanced that, in countries where rye has long been important in national diets, the probable course of development, even over

a very long period, may be the striking of a definite balance between the use of wheat and the use of rye rather than the complete displacement of rye by wheat. A further important fact revealed is the general difficulty of securing reliable statistics of past wheat consumption.

The investigation regarding the spreads that have existed between wheat prices in England during the past decade was in part an attempt to test the feasibility of establishing a set of price differentials on import markets, such differentials to reflect the differences in the types, grades, varieties, and qualities of the various wheats imported. The study reveals that, in practice, the spread between the prices paid for different kinds of wheat has been subject to rapid and wide variations, thus indicating that the price paid was at least partly determined by factors other than the precise character of the wheat itself. Six other factors are listed. The general conclusion is that the arranging of fixed price differentials is a much more complicated matter than many advocates of the idea have supposed.

Of very special significance is the excellent and timely analysis of the problem involved in attempting to plan the production and distribution of wheat internationally. It is impossible here to do more than commend the author for having produced an exhaustive treatment of a most important subject and to commend the study itself to all students who are interested in the general subject of international planning. Generally speaking, the possibilities of successful planning in respect of wheat are held to be distinctly limited. Of particular interest is the well substantiated claim that wheat is a commodity which is inherently unsuited for international planning purposes.

W. M. DRUMMOND

University of Toronto

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*The International Protection of Labor, International Labor Organization, History and Law*, by Boutelle Ellsworth Lowe. New York: The Macmillan Company. 1935. lxxiii, 594 pp. \$3.50.

This volume consists of a short historical summary of the international labor movement, an extensive collection of documentary material, and a bibliography of the publications of some eleven countries. The summary discusses the part played by socialists, trade unionists, social reform groups, and governments. There is also an account of the various congresses, labor conferences, and labor legislation recommended and adopted. One chapter is devoted to the relation of America to the movement, another to the arguments for and against international labor regulation.

In the first edition the author carried the history of the movement down to the Second Session of the International Labor Conference at Genoa in 1920. The present edition extends the history through the Eighteenth Session of the International Labor Organization (1934). The new material includes a brief description of the later sessions of this international body, of recent social legislation in the United States and its relation to the movement, of

our acceptance of membership in this organization, and of the change in membership of the governing body of the organization. The documentary history has been brought up to date and a short bibliography of recent publications added.

The author's investigation of this subject has led to a strong conviction in support of international labor regulation. His treatment, however, of the arguments for and against such regulation does not adequately examine the economic factors in the problem. More attention, for example, might have been given to such factors as unequal distribution of resources, population, capital, and business ability. They represent barriers which if not insurmountable are just as serious as political and social factors in limiting the possibilities of international action with reference to labor. Again the changing character of competition and international trade, the development of new industrial techniques, the growth of nationalism, and the attempts at self-sufficiency and economic planning all suggest new elements in the problem which need evaluation. A discussion of some of these factors would have been helpful.

The author has, however, succeeded in bringing together a very useful collection of documentary material and a valuable bibliography. He has given a brief and concise account of this international movement.

J. W. HOWELL

Carnegie Institute of Technology

*The Measurement of Population Growth*, by Robert R. Kuczynski. London: Sidgwick & Jackson, Ltd. 1935. vi, 249 pp. 12s. 6d.

This excellent book should be of much help to those working on the larithmics of population growth because of its analysis of census and vital statistics and of methods of measuring fertility, mortality, and natural increase. Emphasis is laid on birth statistics and on rates of fertility, gross reproduction, and net reproduction, since "the decisive factor in determining present population growth is fertility" rather than mortality as in former times. Frequent references are made to studies of historical interest, and throughout the book the points under discussion are liberally illustrated by retrospective tables for many countries (27 full-page text tables and many more smaller tables). Although listed as one of a series of "Text Books of Social Science" there is no bibliography, list of suggested readings, or questions for discussion as in so many American texts. Perhaps because the book is published in England the analysis and criticism of English vital statistics and reports of the Registrar General is in much greater detail than that of other countries, covering nearly 40 pages.

The appraisal of birth statistics (Chap. I) deals with simple tests for completeness, the basis of classifying stillbirths and live births, and the allocation of legitimate births and illegitimate births among single, married, widowed, and divorced women. The need for careful scrutiny of basic data is emphasized.

Vital statistics alone have been used in measuring fertility, especially in the past; e.g., ratio of births to marriages, etc. (Chap. II). The numerous errors inherent in these methods are pointed out and attempts at correction discussed. Because the latter can only be partially successful at best, the conclusion is that if census data are available there is no excuse for depending entirely on vital statistics.

Census statistics alone permit fertility to be measured much more accurately than do vital statistics alone; e.g., ratio of children to women, and number of children born to each woman (Chap. III). However, the latter method—as used and made world famous in the English Census of 1911—has serious drawbacks.

Measures of fertility based on both vital and census statistics discussed in Chap. IV include crude birth rate; general, specific, and total fertility rate; and gross reproduction rate of all women. Of these the last is the most accurate but requires the most basic data. Several methods of estimating it, and certain substitutes for it, are analyzed and held inadequate, including standardized birth rates computed by the indirect method and fertility rates derived from a single census but applied over a long period.

In Chap. V defects in early life tables are pointed out together with improvements made at later dates. Special emphasis is laid on “the features with which the student of population growth must be familiar in order to be able to use a complete life table and also to construct an abridged life table sufficiently correct for measuring the net reproduction of a population.” Crude, life table and standardized death rates are compared with respect to their accuracy in measuring mortality to the advantage of the second, and showing crude preferable to standardized under certain conditions.

Attempts to measure the balance of births and deaths by the vital index are held to be futile and outmoded (Chap. VI). A much superior concept is the net reproduction rate; a still better concept is the rate of increase of a stable population, i.e., a population constantly subject to present specific fertility and mortality rates. Methods of calculating both are explained.

Although this book seems to the reviewer to be an excellent work, there are a few minor criticisms that may be pertinent. At places the author is rather dogmatic, for example, “The [Mexican] figures for 1931 and 1932 may be accepted as fairly accurate” (p. 8). Moreover, unless one is omniscient it would seem desirable to qualify such a statement as “The first fertility table was calculated in 1884 by Richard Böckh” (p. 207), since further historical research may bring an earlier table to light.

Probably because the author has worked more with European vital statistics and the reviewer with American there are points of disagreement centering around the analysis of ratio of children to women, a measure of fertility more useful in this country. Since most mothers who migrate take their children with them, the reviewer disputes that “it was utterly misleading to relate the 90,815 children under 10, enumerated in Ohio in 1810 to the 39,426 females from 16 to 45 enumerated in 1810, since those females, in



1800, numbered 7,203 only." A ratio of children to women would be misleading, however, if mothers (but not children) were suddenly decimated shortly before the census and migrated to heaven unaccompanied. Furthermore, Rossiter's proposal to relate children under ten to the mean population of the preceding decade (p. 98) is not accepted by the reviewer as progress. Where there has been much migration it is a step backward, giving spuriously high ratios under inward migration (as in the Ohio case above) and spuriously low ratios under outward migration. Of course it is as true with general fertility *ratios* as with general fertility *rates* that the age distribution of women in the childbearing period cannot be neglected.

On pages 192-194 an analysis of English data shows the standardized death rate to be inferior to the crude in indicating trends in mortality, taking the correct (life table) death rate as the ideal measure. With the correct death rate and hence the standardized death rate tending to become stationary as more difficulty is experienced in lengthening the expectation of life, and with the crude death rate tending to rise as the age composition of the population becomes less favorable, the reviewer believes an analysis of English data thirty years from now will lead to the opposite conclusion.

P. K. WHELPTON

Scripps Foundation for Research in Population Problems  
Miami University

*Blindness and the Blind in the United States*, by Harry Best. New York: The Macmillan Company. 1934. xxii, 704 pp.

This volume, which is a revision and expansion of Dr. Best's earlier work, *The Blind*, published in 1919, is a comprehensive reference book designed to cover all phases of the prevention of blindness and the work for the blind in the United States. Exhaustively documented and heavily interspersed with statistical tables, it arouses the reader's admiration for the patient industry with which the author pursued his task, seeking only to dignify by academic procedures and factual data the cause of the blind—a group about whom all too little literature is available, and that little too often colored by sentiment or prejudice.

Respecting, as one must, Dr. Best's devotion to his purpose, one regrets more deeply the defects in the material with which he chose to deal. His book is based very largely upon the census of blind persons taken in connection with the general population census of 1920, in which 52,567 blind persons were enumerated. The United States Bureau of the Census authorities themselves acknowledged that this enumeration was probably only 65 per cent complete; workers for the blind, basing their opinion on the registration of the blind in certain well-organized states, estimate that it was probably only about 50 per cent complete.

Therefore, if the figures presented in the census report are to be regarded as having validity, it is necessary to assume (1) that the enumeration was equally incomplete in all parts of the country, and (2) that those blind per-

sons reported are truly representative of the total blind population as regards age, sex, race, cause of blindness, occupation, etc. Unfortunately, no grounds for either assumption can be shown. It is entirely possible, for instance, that the blind in urban areas were more completely reported than those in rural districts, that children of pre-school age were more likely to be omitted than older brothers and sisters in school, and that blind persons employed in subsidized workshops were more frequently included than those who lived with and were supported by their married children. There is no means of resolving these questions, for they are inherent in the census method when it is applied to a group so scattered, so heterogeneous, and so difficult to define. (England has substituted for the census of the blind a scheme of national registration with excellent results.) But, in view of these important factors of unreliability in the basic data, the tabulations and analyses based upon them are of questionable value.

Even if the census figures could be assumed to be either complete or representative, it must be noted that they were gathered in 1920, fourteen years before the publication of Dr. Best's book, and make no allowance for the developments in the social and industrial world since that time, by which the blind, no less than the seeing, have been affected. In explanation, it should be stated that, on most points, no more recent census data were available, for the 1930 census of the blind was limited to the items appearing on the general population schedule.

It may well be that Dr. Best's greatest contribution lies in having focused public attention on the crying need for reliable, comprehensive, and up-to-date statistics of blindness and the blind.

EVELYN C. MCKAY

American Foundation for the Blind

*Foreign Bondholders and American State Debts*, by Reginald C. McGrane.  
New York: The Macmillan Company. 1935. vii, 405 pp. \$4.00.

Serious depressions bring with them the contraction of credit and the cessation of loans. With reduction in economic activity, taxes become less remunerative and more painful to bear, and many governments find difficulty in meeting their obligations. In the international field the stoppage of loans and purchases by the creditor country makes it difficult if not impossible for the debtor countries to find the exchange with which to pay interest on previous borrowings. Accordingly, there is always in such cases the possibility of defaults upon governmental bonds as well as upon private obligations. The two crises which illustrate to us most strikingly the weakness of governmental credit in such emergencies are those of 1837 and 1929. Americans played the part of debtors in the first and of creditors in the second. During the early 1840's nine American states failed for a time to meet their interest charges; and, of these, four repudiated all or a part of their obligations. In the present depression the war debts due to the United States have been defaulted by all but one minor debtor, and twenty foreign govern-

ments have ceased interest payments on bonds held by American citizens. Thirty-two per cent of the American-held foreign bonds have been in total or partial default. In each case the situation has been so controlled by the implacable limitations of governmental finance and international exchange that the will of any set of governmental officials has been rendered to a large degree powerless. Nevertheless charges of moral perfidy have been hurled at debtors by creditors. In 1843 the Reverend Sydney Smith, because of the failure to receive the interest on his Pennsylvania bonds, declared:

A great nation, after trampling under foot all earthly tyranny, has been guilty of a fraud as enormous as ever disgraced the worst king of the most degraded nation in Europe.

American denunciations of European nations in recent years have been similarly lacking in restraint.

Professor McGrane has done an exceedingly useful task in reviewing at this time the defaults and repudiations of American states in the forties of the last century. There were two principal problems connected with the debts, the difficulty of collecting sufficient taxes to bring into the state treasury enough funds to meet the debt charges, and (this applies only to that part of the debts held in foreign countries) the obstacles of international exchange in the transmission of payments to bondholders abroad. The author devotes himself almost entirely to the first of these difficulties. He traces fully and clearly the defaults and repudiations that occurred in the individual states, the resulting sentiment in Europe and in this country, the failure of the movement for Federal assumption of the debts, the pressure for the resumption of payments, and the revenue programs of the states. He also traces the comparatively swift revival of foreign confidence in American governmental obligations which began about 1848. A second wave of defaults and repudiations came in the seventies following the reckless financing under carpetbag governments in the Southern states. The fall of the carpetbaggers was followed by repudiation. Many Southerners naturally felt that there was no moral obligation to pay these bonds.

The volume is a valuable part of American literature on public finance. Should the student of government wonder why limitations upon the financial powers of legislatures have been placed so profusely in state constitutions, he may find his answer in these pages. And the impatient nationalist who constructs his whole scheme of international values on the financial relationships of the last two decades should turn here for perspective and understanding.

BENJAMIN H. WILLIAMS

University of Pittsburgh

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*Analysis of the Real Property Inventory and Financial Survey of Urban Housing for Peoria, Illinois*, by the Research Division of the Federal Housing Administration. Washington, D. C. 1935. vi, 194 pp.

This book of 194 pages includes 53 half-page charts each accompanied by a brief tabulation of the data shown on the chart, 20 large folded-in maps,

199 tables segregated to the appendix, and 55 partly filled pages of text equivalent to approximately 42 full pages.

Part I deals with the economic background of the city: population, composition and growth; business activity; income tax returns; postal receipts; marriage licenses; and similar data from which it was concluded that Peoria is economically sound.

Part II deals with the housing situation in the city as a whole: trend in ownership and mortgage encumbrance; age and condition of structures by monthly rental; number of rooms by type of dwelling; congestion by rental; rent delinquency; mortgage indebtedness; source of mortgage money; interest rates; and a multitude of other data including income data.

Part III deals with the housing situation, analyzing by blocks, land use, vacancy, congestion, tenure, condition of dwelling, facilities, values, rents, and so forth, based on the real property inventory.

Vacancy is calculated on rented and vacant family units, assuming that all vacant family units are for rent when, as a matter of fact, probably some of them are for sale only. Blocks in which most homes are owned show high vacancy ratios calculated in this manner. Vacancy is usually based on the sum of the units owner-occupied, the units tenant-occupied, and the vacant units.

The data obtained from the Financial Survey of Urban Housing determined by an enumeration of each tenth block and by mailed schedules received from a part of four-tenths of the blocks have been analyzed by enumeration districts in a more detailed manner, including figures on income, rent delinquency, age of dwellings, mortgaged homes, and delinquency.

These enumeration districts were combined into economic areas based on opinions obtained from people in Peoria. This section, as might be anticipated, was not productive of as helpful material as it might have been if the economic areas had been created from the analysis of the data made available by the study.

Part IV deals with factors affecting property values.

Several attempts were made to test the stability of the small areas by determining the change of values, rents, and income between 1929 and 1934. In a less abnormal period such tests might be expected to be worth while.

Changes in income may be quite misleading unless it is fully recognized that comparisons have been made of the income in 1929 and 1932 of each group based on 1933 levels rather than being grouped on 1929 and 1932 levels respectively. This limitation does not affect the validity of the average incomes during each of these three periods, but the distribution of the families in income groups of 1933 only are of value.

The publication is most attractive; the colored maps are excellent, the charts clear and easily understood in spite of the fancy printing used in the titles.

The report serves a useful purpose. As the author states, "this report is of primary significance in illustrating a technique for treatment of data pro-

vided by the Real Property Inventory and the Financial Survey of Urban Housing and by surveys of a similar nature."

HOWARD WHIPPLE GREEN

Real Property Inventory of Metropolitan Cleveland

*The Building Industry and Business Cycles*, by William H. Newman.  
Chicago: University of Chicago Press. 1935. vii, 73 pp. \$1.00.

This monograph contributes materially toward an understanding of the causes of building fluctuations and of the role of building in business-cycle phenomena. After emphasizing the importance of distinguishing major and minor building cycles, Mr. Newman says, "Of prime importance to an understanding of these major cycles are shifts in population and the events associated therewith. . . . A shift of population geographically is as important as an increase in the total . . . shifts in population occur in waves—waves which correspond very closely with the major building cycles." These waves in population movements anticipate major changes in building activity by a year or two.

The relationship of money-market conditions to major movements in building is less close. Although availability of long-term funds will contribute to the major-cycle rise, once it is under way, "the pressure for new buildings may be sufficient to outweigh even tight money-market conditions." Concerning building costs, no evidence was discovered that they "are the controlling factor in constructional activity. While costs usually moved independently of building, such connection as was found suggests that changes in building activity cause changes in building costs, rather than vice versa."

Although major building cycles undoubtedly "affect the shape and the duration of business cycles, . . . it is the minor fluctuations in building which correspond in nature and time limit to business cycles." Because of the critical importance of building trends at turning-points in business and the "independence of the two series in minor movements and in whole cycles," it is contended that "building fluctuations arise, to a considerable extent, independently of 'business cycles.' " When the direction of business is in the balance, however, the building industry is often of critical significance. The role played by financial conditions is far more important in minor building cycles than in major building cycles.

Of especial interest is the chapter in which Mr. Newman discusses the bearing of his conclusions upon business-cycle theory. For example, the theory that changes in production costs cause inverse fluctuations in business activity is not substantiated by the analysis, since fluctuations in building activity were found to be independent of the level of building costs. In regard to the role played by uncertainty in business-cycle phenomena, it is argued that "the longer the period necessary to change the supply brought onto the market and the more sluggishly the market reflects a change in

supply or demand, the more extreme will be the overexpansion or overcontraction. Experience of the building industry clearly indicates that this element of uncertainty plays a part in fluctuations of activity."

Proposed means of stabilizing the building industry are not considered encouraging. "In the main, a choice must be made between (a) budgeting production which involves the regimentation . . . of economic life, and (b) fluctuations in activity arising as a consequence of an uneven rate of progress." The author clearly feels that a considerable degree of stagnation is inevitable under the former plan and that the latter plan combined with certain methods of mitigating the fluctuations is to be preferred.

F. L. CARMICHAEL

University of Denver

*Real Property Inventory of the Cleveland Metropolitan District*, Report No. 4 of the Real Property Inventory of Metropolitan Cleveland (takes place of Volumes No. 1 and No. 2), by Howard Whipple Green. 1935. 291 pp. \$15.00.

*Movements of Families within the Cleveland Metropolitan District 1934*, Report No. 5 of the Real Property Inventory of Metropolitan Cleveland (takes place of Volume No. 3), by Howard Whipple Green. 1935. 223 pp. \$15.00.

These volumes are primarily data books in significant fields over which fog abounds. The immediate light they bring may be mainly of benefit to the people of that district and people outside the district who have important interests there. But it may be assumed that until specific data of the same kind are available for other great urban areas the information on the Cleveland area will be taken in many ways to illuminate urban conditions elsewhere. Moreover, the stimulus from the Cleveland surveys has already been widely felt, and the accomplishments there in the development of method are reflected in many other community inventories. Since these reports come from what is largely a pioneering project, the purpose of this review will be mainly to introduce the volumes.

*Real Property Inventory of the Cleveland Metropolitan District* is the third annual report of that name issued under the direction of Howard Whipple Green. In 1932, under his direction, an enumeration was made in the Cleveland metropolitan district of dwelling structures, family dwelling units, residential occupancy and vacancy, the several types of non-residential buildings, and stores. The survey was made with the cooperation of the post office, the postal carriers doing the field enumerating. A similar count was made in 1933 and another in 1934. Each enumeration was tabulated and reported, the volume at hand following the 1934 survey. In addition to the most recent data gathered by the postal carriers, each report included information for a number of years on subdivision activity, deeds, mortgages, foreclosures, building, and demolition. This third volume is enriched by the inclusion, both in tables and in the accompanying text, of much information

from the two earlier enumerations. In addition, there are two significant reports on special surveys, one a study of use of street frontage on main business thoroughfares, and the other an industrial survey. The extensive data from the Federal R.P.I. of the Cleveland district are not included but are published separately.

Although useful summary information for the metropolitan district and for each of the political subdivisions is given, Mr. Green has shown especial interest in the presentation of census tract data on dwellings, stores, office buildings, lots and unallotted acreage, new subdivisions of land, new construction, and demolitions. The census tracts, it should be noted, are relatively small, there being 321 in the Cleveland metropolitan district. The report on street frontage is handled by political subdivisions, then by streets, then by street segments of a few blocks each. The information on industries and industrial space is presented for each of ten geographical sections. Summary charts also are used, but most of the graphic presentations, like most of the tabular pages, are built of data for the small areas. The very sharp differences among areas, brought out clearly by numerous shaded maps, show fully the justification for Mr. Green's persistence in dealing with neighborhood units.

In *Movements of Families within the Cleveland Metropolitan District*, as in the other volume just discussed, Mr. Green's emphasis rests on the presentation of census tract data. This volume is the second issued under that title, the first being based on 1933 data and this one on 1934 data and on information for the two-year period. Movements within the district and movements out of or into the district were studied, on the basis of public utility records. One accustomed to the rather solid look and feel of Cleveland is confronted here with an astonishing picture of a huge continual shuffle of population. The enormity of the movement is probably in part a reflection of depression conditions. But there are always many families, many neighborhoods, and many properties in depression. Moreover, the well-remembered scramble for quarters in better years indicated that moving is also a boom phenomenon. Probably, therefore, movement of families is always of large volume; but there had been no large-scale study of such movement prior to that in the Cleveland area.

On one feature of the presentation of the data in these volumes, there seems to be just cause for criticism. Only the last six of the numerous tables in the first report are numbered; none in the second. None of the charts and maps are numbered, nor are any keyed by direct reference to appropriate tables. Occasional errors or ambiguities of reference in the first of the two volumes are directly traceable to the lack of numbering. In the second, the difficulty has to be handled by numerous page citations.

The text, serving as helpful introduction to the statistical material, is useful also because of the inclusion of much information from the earlier surveys. In the first of the two volumes, however, some of the assumptions appear dubious. Two significant instances will be noted. The degree of non-competitiveness assumed with reference to different areas and different types of

property (page 3) seems too high, in view of the notable differences among areas and among types of property, shown in the same volume, with respect to change in residential vacancy, in subdivision, and in new building. There is an assumption (page 8) that vacant family units unfit for use probably will not be occupied again and that occupied family units unfit for use will be vacated by improved income of the occupants or by condemnation and razing. But most slum property was occupied in the best times we have experienced; that occupancy was not confined to those who couldn't afford better quarters; and condemnation and destruction of unfit property, except in relatively limited degrees, remain yet a mere aspiration. This assumption, therefore, appears to be more a wish than a carefully weighed expectation.

It is unfortunate that Mr. Green did not address himself to the specific task of indicating social uses of the data offered. At this rather advanced stage of his work, he would no doubt have been able to offer a helpful contribution in that respect.

J. P. WATSON

University of Pittsburgh

*Insurance and Annuities from the Buyer's Point of View*, by E. C. Harwood and Bion H. Francis. Cambridge, Massachusetts: American Institute for Economic Research. 1935. xiv, 167 pp. \$2.50.

The authors would probably claim little originality in their description of life insurance and annuity contracts. This is probably the most accurate portion of the work, although it lacks the care in arrangement which might have contributed to clarity. Unfamiliarity with the science of life insurance is evident at many points, as in the emphasis placed upon "expectation of life" and the "most probable year of death," in regarding mortality and loading salvages as "profits," in confusing the value of a company's assets with the value of its reserve, and in failing to distinguish between "actual history" and "present scale" bases for dividends. Throughout the entire book is evident a total lack of appreciation of the services which life insurance may render in relation to thrift, investment, and the meeting of emergencies—a lack so glaring in view of modern life insurance developments as to disqualify the authors for their assumed role of expert advisers.

Possibly the only sections of the book which might be regarded as original are those concerned with the rating of companies and the comparison of contracts as to cost. These are so obviously superficial and ignore so many factors which should enter into any equitable comparisons as to be dangerously misleading to the reader who acts on them. Their hazard is aggravated by suggestions on the replacement of old policies with new ones, a practice which has been vigorously and properly opposed by companies having the welfare of their policyholders at heart.

It is very strange that a book which purports to be unbiased and which is published under the imprint of an organization whose name closely resembles that of a well-known scientific body should contain in the main-part of the



text an offer to provide certain reports, analyses, or detailed study for a stated scale of fees, a form also being provided in the appendix for the reader to use in submitting information on his personal insurance program. After seeing this, one cannot help but quote a passage which was applied (of course) in another direction: "It simply is not reasonable to expect sound and unbiased advice regarding the product they are selling from the people who have it for sale."

The writer of this review agrees with the authors that "for a large portion of all buyers, their life insurance policies are the most important purchases made throughout their lifetime." Buyers need sound advice. But the field is still open for a good book from their point of view.

DAVID McCANAN

University of Pennsylvania

*Cyclical Fluctuations in Commodity Stocks*, by Ralph H. Blodgett. Philadelphia: University of Pennsylvania Press. 1935. xii, 172 pp. \$2.50.

Business cycle analysis must include an explanation of what happens to stocks of goods during the various phases of the cycle. Yet writers on the subject have been content to rest the case with a deductive argument on what ought to happen to such stocks. Comparatively little statistical verification of these deductions exists. This book is a report of a rather exhaustive statistical study carried on for the purpose of filling in the gap in our information concerning the behavior of stocks of goods in prosperity and depression.

The stocks of 35 different commodities have been analyzed for the period from 1919 to 1932. For each commodity the cyclical changes in stocks of goods have been compared with the cyclical changes of (a) general business, (b) production, (c) prices, (d) consumption. These comparisons provide a vast amount of detailed but valuable information. It is impossible to summarize this information within the compass of a brief review. The stocks of some commodities have inverse cyclical movements with reference to general business, but positive movements with reference to production or price. A number of other such combinations appear in the course of the study.

The author finds no such general uniformity of behavior of stocks of commodities as the usual cycle analysis would imply. The nearest thing to a generalization which he is willing to hazard is the following:

those stocks of raw and partly-processed materials and of finished products at the producers' which increase and decrease as general business expands and contracts are, in general, very small at all times, while those stocks which are, in general, large in size show cyclical fluctuations which are inverted to those in general business.

The statistician interested in method will find this volume something less than satisfactory, because the description of the method is too brief and because none of the data or analyses are presented. The method of treating the data for trend, seasonal, and cyclical components is that developed by

Professor Kuznets. No critical analysis of the accuracy of the application of the statistical method is possible because of lack of information.

This book is a decidedly valuable addition to the literature devoted to analysis and verification of business cycle theory. The reviewer feels that in several instances conclusions have been drawn which will require revision when data for a period longer than 12 or 14 years become available.

M. A. BRUMBAUGH

University of Buffalo

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*Retail Price Behavior*, by John H. Cover. Chicago: University of Chicago Press. 1935. viii, 92 pp. \$1.00.

Professor John H. Cover was delegated by the Committee on Government Statistics and Information Services to study the problem of the more adequate collection and analysis of retail prices. *Retail Price Behavior* is a first report of the results of this investigation and contains not only the recommendations made to the Federal Inter-departmental Committee but also inferences for which Professor Cover assumes sole responsibility.

The purpose of the project was twofold; namely, to identify and measure some of the factors affecting retail prices and to propose an organization and procedure for collecting and analyzing prices. Although these objectives were inspired by needs arising from the National Industrial Recovery Act and the Agricultural Adjustment Act, their attainment is obviously of value to economists in general. In determining "real" wages, for example, a need has long been felt for a more adequate breakdown of cost of living data.

Of particular interest is the list of communities proposed as an adequate basis for a national pricing system. These communities represent the regional, population, industrial, trade, climatic, and social variations in the United States. Of these 237 communities, eight have been selected for the test survey of prices which is analyzed by Professor Cover. On the basis of this test survey, recommendations are made concerning the measurement of price variations attributable to differences in types of commodities, of communities, and of retail stores. The remarks on sampling problems will be of interest to any one engaged in market research.

Although *Retail Price Behavior* reports only a small step taken toward the complete attainment of a national pricing system, the immensity of the undertaking is made clear, and, by the sound recommendations on organization and procedure, further progress is made less difficult.

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*Financial Aspects of Corporate Net Worth*, by Arthur H. Winakor. Bureau of Business Research, University of Illinois Bulletin No. 50. 1935. 34 pp.

*Changes in the Financial Structure of Unsuccessful Industrial Corporations*, by Raymond F. Smith and Arthur H. Winakor. Bureau of Business Research, University of Illinois Bulletin No. 51. 1935. 44 pp.

The work of the accountant furnishes the raw data for presenting satisfactory information to the business manager and investor. These facts cannot be used in their original form but need to be developed into ratios, averages, etc., developing standards and other suitable means of comparisons before the layman is able to grasp the true meaning of the figures, spread on the balance sheet and income statements. The two studies indicated above are efforts at such analyses. Teachers of corporation finance should welcome such investigations, for they add content to the study of some very practical problems.

The first study is an attempt to show the value of a careful analysis of net worth as a guide to a proper interpretation of the financial position of any corporation. The author realizes that net worth depends upon estimates made by engineers and accountants but that, when properly analyzed, they will give satisfactory clues for practical judgments. From the small sample used, a conclusion is drawn that successful corporations increase their net worth relative to total assets, and in periods of prolonged depression, this relative increase is accelerated. If one ties up the second study with the first, Mr. Winakor might have strengthened his proposition by concluding that where corporations fail to increase net worth relative to total assets they are headed for the rocks. The statistics offered in the second study point to the conclusion that the gradual decrease of net worth to total assets is a danger signal for both business man and investor.

The second study is an attempt to show that it is impossible to get a complete picture of the financial position of a corporation by the use of any one ratio. Alexander Wall, in his studies of ratio analysis, pointed this out several years ago. The present study is of particular interest in its attempt to select certain ratios and to present statistical data to substantiate the argument. Working capital to total assets is suggested as an unfailing guide to the financial position of a corporation. The authors contend this ratio is a more accurate guide, and it gives its cue much earlier than other current ratios. Current assets to total assets appear to give as clear an indication of the financial position, and even net worth to total assets gives a similar picture. These are merely suggested as an indication that probably the authors were too intent on stressing the significance of the working capital ratio to see the significance of other important ratios.

JACOB SWART

Colorado College

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*Control of the Retail Units of Chain Stores*, by Edgar H. Gault. Bureau of Business Research, University of Michigan. 1935. 99 pp. \$1.00.

This monograph discusses four main types of control as practiced by various chain store organizations; namely, control of merchandise, of inventory, of finances, and of personnel. The material presented is based on data obtained from articles appearing in periodicals, particularly the *Chain Store Age* and from interviews with the executives of 62 chain organizations.

The chains included in the survey cover a wide range with regard to the features which the author shows influence the operating and control methods; in type of merchandise, from variety to furniture; from small local chains to national chains; in number of outlets, from an average of 7 in confectionery and restaurant chains to 3,260 in grocery chains.

The material represents, therefore, a large cross-section of American chain stores, and the author outlines in a clear and concise manner the principal features of their operating methods under the headings mentioned above. A few of the topics covered are: How and why certain chains maintain a policy of uniform stocks and prices; what kind of chains send window display suggestions or materials from the central office, whereas others leave such displays entirely to the store manager; why restaurant and meat chains usually use the cost method of inventory, whereas most other chains use the retail method; the control of expenses through contracts, receipted bills, budgets, and comparisons among stores; and the range of responsibility placed on the manager of the retail store, depending upon the size of the store, the training and experience of the manager, and the amount of direct supervision possible.

Professor Gault states that he is unable to obtain statistical data on the results of the various methods of control and is therefore unable to evaluate them. A person about to set up a chain store organization, however, may find in this book a résumé of the various types of controls now being used under certain conditions, but the details of the control methods are missing. No samples of printed forms or of reports are given to illustrate reports mentioned. It seems strange, also, to find no bibliography. Although the literature on chain stores is not extensive, similar methods of control are used in department stores, and references to more complete description of control methods would be useful. For instance, Professor Gault gives a rather elementary outline of the retail method of inventory; for a more complete analysis of this subject, reference might well have been made to McNair's *Retail Method of Inventory*.

MARIE P. SEALY

R. H. Macy and Company, Inc.

*High-Level Consumption—Its Behavior; Its Consequences*, by William H. Lough, with the assistance of Martin R. Gainsbrugh. New York: McGraw Hill Book Company. 1935. xiii, 330 pp. \$4.00.

High-level consumption is not specifically defined by Mr. Lough, but several statements made by him can be pieced together into an implied definition. In the seven years 1923-1929, "more than three-fifths of American families, according to competent estimates, after covering their subsistence requirements had money to spare for comforts and luxuries. . . . The essentially different character acquired by consumption when it climbs well above the subsistence level is only vaguely understood. . . . One plain char-

acteristic of high-level, in contrast with low-level, consumption is its fickleness. . . . An associated characteristic is unpredictability."

This "high-level—that is, a fickle and unpredictable—consumption" is then measured, analyzed, and forecast in so far as the facts will support forecast. Finally, the book seeks "a factual, rational answer to the life-or-death riddle which is posed to our generation: how to attain a lasting workable balance between expanding productive capacity, on one side and a high-level . . . consumption, on the other side."

The measure of consumers' outgo for the period 1909–1931 is obtained by the following steps: (1) "Producers' values of all classes of commodities which are, in whole or in part, ready-for-purchase by consumers" are tabulated, partly from actual figures reported in the Census of Manufactures, Census of Mines, etc., and partly from estimates as, for example, the value of home-grown, home-consumed goods. (2) Imports are added to and exports deducted from the producers' values. (3) The estimated proportion of each class of commodity taken by consumers is then applied to the producers' values to obtain the estimated producers' values of consumers' goods. (4) The estimated spread between producers' values and prices paid by consumers are added to the producers' values for each class of commodity. (5) The index of department store stocks reported in the *Survey of Current Business* is used to adjust for inventory changes. At this stage the figures represent estimated "Consumers' Outgo" for commodities at current (unadjusted) dollar values. (6) Total outgo for personal services in each year is estimated by multiplying the estimated number of persons engaged in various professional, commercial, and domestic occupations by the estimated average gross earnings. (7) Total outgo is estimated for other intangibles, such as transportation fares, automobile insurance and taxes, gasoline taxes, home rentals, imputed rental value of owner-occupied homes, public utility services, moving expenses, club dues, theatre tickets, postage, foreign travel, etc. (8) An estimate is made of the amount of each class of intangibles taken by consumers. (9) The amount of taxes paid directly by consumers and the amount of savings out of current individual incomes are estimated and classed as "Outgo for Withholdings." (10) Total "Consumers' Outgo" for commodities, for intangibles, and for withholdings for the period 1909–1931 is then classified into twelve major groups of expenditure items.

The data are then adjusted for changes in the general price level for the analysis of "Consumers' Outgo" and for changes in the price level for each class of commodity or service for the analysis of "Consumers' Takings."

The analysis of the data and the conclusions drawn are extremely interesting. The grouped data on "Outgo" and "Takings" are analyzed in terms of their proportionate distribution among classes of goods, their trends, their stability and instability, their relation to subsistence vs. "free spendables," their relation to buying motives, and their elasticity. On a basis of the analyses made and the conclusions drawn forecasts are presented concerning the probable distribution of "Consumers' Outgo" if the average family outgo should increase by varying amounts. Finally, it is suggested that in-

stead of national planning, we need greater flexibility in the economic system with more information, more widely disseminated, and more intelligently utilized by private business.

The entire book is built around a framework of estimates. The authors frankly admit the weakness of many of their estimates, but point out the lack of actual data. Some of the conclusions drawn, however, are conditioned by the hypotheses and methods used in estimating. For example, the statement is made that distribution costs paid by consumers have had "a definite, though slow, downward trend. The trend arises not so much from changes in margins as from gradual modification of the make-up of consumers' purchases." For all commodities, with a very few exceptions, a constant proportion of producers' values is allowed each year as spread between producers' values and prices paid by the consumers.

Further, with a few minor exceptions, a constant proportion of each class of commodities is assumed to have been purchased from year to year by consumers. Finally, changes in the distribution of consumers' outgo from year to year are analyzed as a function of changes in the average family total expenditure. Changes in the distribution of families' income and spending levels are not known and are, therefore, not taken into account.

EMMETT H. WELCH

State Emergency Relief Board  
Commonwealth of Pennsylvania

*Regional Shifts in the Bituminous Coal Industry, With Special Reference to Pennsylvania*, by Wilbert G. Fritz and Theodore A. Veenstra. Pittsburgh: University of Pittsburgh. (Bureau of Business Research Monographs Number 4.) 1935. 197 pp. \$2.00.

This book is a substantial addition to the vast literature on coal. The darkest spot in the store of information on coal is in the field of marketing and distribution, and this book does much to throw light on this field. Though the study revolves around the competitive markets for Pennsylvania coal, a great amount of data are presented concerning the markets for coals from other producing districts.

The major portion of the book is devoted to a detailed analysis of the origin and destination of shipments of bituminous coal from Pennsylvania. Conversely, an analysis is made of the source of coal received in the principal markets, and the proportion that came from the Pennsylvania districts. In addition, material is assembled on consumption of coal by uses, and so far as possible the consumption by use is traced from the origin district to the place of use. The many shifts that have taken place in the competitive arena are pointed out, and a serious effort is made to give the reasons for the shifts. Such a study is of great value to both producers and purchasers of coal.

The second part of the book deals with the public interest in bituminous coal and discusses a national policy for the industry. The authors give a

very able analysis of the problem, review the past and proposed remedies, and make a critical appraisal of the proposed remedies.

All those interested in coal or in the social control of industry will find this book of value.

W. H. YOUNG

U. S. Bureau of Mines

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## CONTENTS

Index Numbers and Public Utility Valuation. By ROBERT W. HARBESON	245
Distinctive Concepts of Price and Purchasing-Power Index Numbers. By WIRTH F. FERGEE	258
The Geographic Distribution of Intrinsic Natural Increase in the United States, and an Examination of the Relation between Several Measures of Net Reproductivity. By ALFRED J. LOTKA	273
The A.A.A., the Cotton Growers, and the Agricultural Problem. By A. B. COX	295
Discussion. By LOUIS H. BEAN	308
Rejoinder	314
Errors of the Second Kind in Testing "Student's" Hypothesis. By J. NEYMAN and B. TOKARSKA	318
The Statistical View of Nature. By MORRIS R. COHEN	327
Discussion. By C. J. DUCASSE	347
Evaluating the Effect of Inadequately Measured Variables in Partial Correlation Analysis. By SAMUEL A. STOUFFER	348
Statistical Method and Industry in Great Britain. By EGON S. PEARSON	361
Legal Aspects of Statistical Activities of Trade Associations with Special Reference to the Sugar Institute Decision. By CHARLES J. BRAND	367
The Poisson Distribution and the Supreme Court. By W. ALLEN WALLIS	376
On the Comparability of Death Rates. By EUGEN WÜRZBURGER	381

## NOTES

Organization of the Central Statistical Board	386
Progress of Work in the Census Bureau	387
An Occupational Dictionary	389
Nominating Committee	390
A Correction	391
Chapter Activities	391
Statistical News and Notes: Bureau of Research and Statistics, Social Security Board (397); Division of Research, Statistics, and Records, Federal Emergency Relief Administration (398); Division of Social	

*Continued on next page*

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# NOTES—Continued

Research, Works Progress Administration (399); Bureau of Labor Statistics, U. S. Department of Labor (401); U. S. Tariff Commission (401); Bureau of Foreign and Domestic Commerce (402); Federal Trade Commission (404); Interstate Commerce Commission (404); Board of Governors of the Federal Reserve System (404); Federal Home Loan Bank Board (405); Farm Credit Administration (405); Bureau of Agricultural Economics (406); National Resources Committee (406); U. S. Public Health Service (406); Children's Bureau, U. S. Department of Labor (407); Women's Bureau, U. S. Department of Labor (407); Office of Education (408); New York State Department of Mental Hygiene (409); National Bureau of Economic Research, Inc. (409); Mathematical Statistics at the University of Chicago (409).

Edgar Sydenstricker . . . . .	411
New Members . . . . .	415

## REVIEWS

Anderson: <i>Einführung in die mathematische Statistik</i> , by A. R. CRATHORNE	417
Davis and Nelson: <i>Elements of Statistics with Applications to Economic Data</i> , by LESTER S. KELLOGG	418
Brown: <i>The Use of Statistical Techniques in Certain Problems of Market Research</i> , by CHARLES F. ROOS	420
Pearson: <i>The Application of Statistical Methods to Industrial Standardization and Quality Control</i> , by S. S. WILKS	421
Vinci: <i>Manuale di Statistica</i> and <i>Virgilio: Statistica</i> , by WASSILY LEONTIEF	422
Eldridge: <i>Public Intelligence, A Study of the Attitudes and Opinions of Voters</i> , by GEORGE A. LUNDBERG	423
Lenti: <i>Analisi di Statistica Economica</i> , by WILLIAM G. WELK	424
Andrews: <i>New Numbers</i> , by W. V. LOVITT	425
International Industrial Relations Institute: <i>On Economic Planning</i> , by JAMES G. SMITH	427
Smith: <i>Economic Planning and the Tariff: An Essay on Social Philosophy</i> , by ABRAHAM BERGLUND	429
Bezanson, Gray, and Hussey: <i>Prices in Colonial Pennsylvania</i> , by R. S. TUCKER	430
Kuczyński: <i>Das Problem der langen Wellen und die Entwicklung der Industriewaren-Preise in den Jahren 1820-1933 und Weltproduktion und Welthandel in den letzten 100 Jahren</i> , by EUGEN ALTSCHUL	432
Smith and Cole: <i>Fluctuations in American Business 1790-1860</i> , by WALTER A. BAUDE	434
Einzig: <i>World Finance 1914-1935</i> , by ELEANOR LANSING DULLES	435
Gayer: <i>Public Works in Prosperity and Depression and Their Utilization as an Agency of Economic Stabilization</i> , by HENRY B. ARTHUR	436
Green: <i>Standards of Living in the Cleveland Metropolitan District</i> , by THEODORE A. VEENSTRA	438
Mears: <i>Maritime Trade of Western United States</i> , by WILLIAM H. KOENIG	440
Alderfer: <i>Earnings of Skilled Workers in a Manufacturing Enterprise 1878-1930</i> , by JACOB J. BLAIR	441
State University of Sofia, Bulgaria: <i>Publications of the Statistical Institute for Economic Research</i> , by V. P. TIMOSHENKO	442
Lokanathan: <i>Industrial Organization in India</i> , by JOHN E. ORCHARD	443
Jacobs and Richter: <i>Die Großhandelspreise in Deutschland von 1792 bis 1934</i> , by BARBARA GOK	444
Bremer: <i>American Bank Failures</i> , by WILBERT G. FRITZ	446
Walker and Randolph: <i>Recording of Local Health Work</i> , by C.-E. A. WINSLOW	447

Continued on next page

# REVIEWS—Continued

Sasek: <i>Les Migrations de la Population Intéressant le Territoire de la Tchécoslovaquie Actuelle</i> , by MARIE JASNY-PHILIPPI . . . . .	448
Borden and Lovekin: <i>A Test of the Consumer Jury Method of Ranking Advertisements</i> , by LAWRENCE C. LOCKLEY . . . . .	449
Rose: <i>Higher Control</i> , by WYMAN P. FISKE . . . . .	450
Industrial Relations Counselors, Inc.: <i>Administration of Public Employment Offices and Unemployment Insurance: Canada, France, Sweden, Switzerland</i> , by EDWIN E. WITTE . . . . .	452
Buck: <i>The Budget in Governments of Today</i> , by CARL SHOUP . . . . .	453
Robinson: <i>The Presidential Vote, 1896-1932</i> and Titus: <i>Voting Behavior in the United States</i> , by HARRY PELLE HARTKEMEIER . . . . .	454



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## INDEX NUMBERS AND PUBLIC UTILITY VALUATION

BY ROBERT W. HARBESON  
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AN IMPORTANT development in the public utility valuation controversy is the recent decision of the United States Supreme Court in *West et al. vs. Chesapeake and Potomac Telephone Company of Baltimore City*,<sup>1</sup> handed down on June 3, 1935, in which index numbers as used by the Public Service Commission of Maryland were declared to be "inappropriate for obtaining the value of a going telephone plant"<sup>2</sup> and a violation of the principle of due process. It is the writer's opinion that on the whole the decision was proper in view of the facts of this particular case, but that if in subsequent litigation it appears that the Court intends this decision to stand as a general condemnation of valuations based upon index numbers it would be an undesirable extension of the scope of judicial review and a barrier to the economical and effective administration of the law governing valuation for rate-making purposes as developed in previous decisions of the Court. Some competent students, who apparently interpret the decision in the latter way, hold that if it is allowed to stand unmodified it may even lead to the complete breakdown of regulation. This situation would be welcomed both by those who desire government ownership of public utilities, and by those who believe that it would lead to the establishment of the administratively practicable prudent investment basis of valuation.

### I

The facts of this case may be briefly reviewed. On November 28, 1933, after extended hearings, the Public Service Commission of Maryland ordered the Chesapeake and Potomac Telephone Company to

<sup>1</sup> 55 Sup. Ct. 894.

<sup>2</sup> *Ibid.*, p. 896.

put into effect on January 1, 1934, reductions in rates which would diminish its annual net income by an estimated \$1,000,000. The Commission had taken the Company's valuation as determined by the District Court in 1923 (about \$6,000,000 in excess of the Company's book value as it then stood) plus the net additions after retirements each year, and had translated these by means of index numbers into an equivalent dollar value as of December 31, 1932. The valuation at which it arrived as of the latter date was \$32,610,327, representing the weighted average of calculations based on sixteen price indices as shown in Table I.<sup>3</sup> On the basis of an estimated net revenue for 1934

TABLE I  
SUMMARY OF INDEXES USED, WEIGHTS ASSIGNED, AND RESULTING VALUES  
IN THE BALTIMORE TELEPHONE CASE\*

Identification of Price Trend	Weights	Depreciated Value
U. S. Department of Labor, All Commodities	4	\$30,458,180
National Assn. of Purchasing Agents-Commodities	2	25,410,849
Dr. Irving Fisher's Trend-Commodities	1	28,681,140
Dun's Trend-Commodities	1	33,581,993
Bradstreets Trend-Commodities	1	24,983,624
<i>Average of Five Commodity Trends</i>		28,623,157
Engineering News Record—Construction	2	35,009,281
American Appraisal Co.—Construction	2	32,623,549
Richey (Old Series)—Construction	2	35,783,737
Consolidated Engineering Co.—Construction	2	34,092,828
Turner Construction Co.—Construction	1.5	33,153,303
<i>Average of Five Construction Trends</i>		34,552,838
U. S. Department of Labor-Building Materials	2	33,132,540
National Assn. of Purchasing Agents Bldg. Materials	1	29,965,050
<i>Average of Two Building-Materials Trends</i>		31,552,838
Federal Reserve Bank of New York—General	2	36,056,408
Charles W. Smith—Baltimore Wages	1.5	30,918,858
United States Department of Labor, Building Materials and Baltimore Wages	0	32,369,324
Interstate Commerce Commission, Railroad Telephone and Telegraph Lines	3	32,024,463
Company Exhibit 35, Western Electric Co. prices. (Less increase since 1929.)	3	34,567,634
Composite Trend by Accounts	0	31,108,325
Maryland Commission's Fair Value Trend		\$32,610,327

\* E. W. Morehouse, "Price Trends in the Baltimore Telephone Case," *Journal of Land and Public Utility Economics*, XI, 318 (August, 1935).

of \$3,353,793 and a return of 6 per cent on the foregoing valuation (\$1,957,271) there would remain net revenue of \$1,396,522. With the rate reduction referred to above there would remain \$396,522 as a "cushion" against rising prices. The Commission accepted the Company's figures for current expense, except that it reduced the annual allowance for depreciation from \$2,173,000 to \$1,720,724.<sup>4</sup> The Company had also insisted on a 7½ per cent return in place of the 6 per cent return allowed by the Commission.

<sup>3</sup> This is the figure for the valuation, without working capital, as of Dec. 31, 1932; the "average value of rate base for 1933" as given on p. 897 of the decision was \$32,621,190. The allowance for working capital was \$660,863.

<sup>4</sup> This is the figure given on p. 895 of the report; that given on p. 896 is \$1,352,284.

Upon appeal to the District Court the Commission's order was enjoined. The lower court held that the price indices used by the Commission were inappropriate for determining present value and discarded them. While, as the Supreme Court said, the lower court purported to consider both book cost and reproduction cost, it actually fixed a valuation equal to the book cost as of December 31, 1933, less the depreciation reserve and plus \$1,000,000 for working capital—a total of \$39,541,921. The District Court also raised the annual depreciation allowance to \$2,000,000. On this basis the net return under the Commission's order would be \$1,742,005, or at the rate of  $4\frac{1}{2}$  per cent on the Court's valuation. The Court held that a return of less than 6 per cent was confiscatory. It will be recalled that the Commission had allowed this return on the basis of the valuation and depreciation figures determined by it.

The Supreme Court expressed dissatisfaction with the methods pursued both by the lower Court and by the Commission. The method of the former was summarily disapproved because the valuation fixed was merely the book cost shown by the company less the depreciation reserve plus an allowance for working capital. "This rough and ready approximation of value," said the Court, "is as arbitrary as that of the Commission, for it is unsupported by findings based upon evidence."<sup>5</sup> It stated further that it was not its function nor that of the lower court to do the work of the Commission by determining a rate base upon correct principles. Nevertheless, although the method pursued by the District Court was thus condemned, its action in enjoining the Commission's rate order was upheld.

The grounds upon which a majority of the Supreme Court rejected the Commission's methods were apparently four in number, as follows:

1. "An obvious objection is that the indices were not prepared as an aid to the appraisal of property. They were intended merely to indicate price trends."<sup>6</sup> Reference was made in this connection to the Interstate Commerce Commission index, which was one of those used by the Maryland Commission, and which, it was pointed out, was not intended to be used "in the determination of unit reproduction costs" upon individual properties.<sup>7</sup> The Court indicated, however, that price trends might properly be considered along with all other relevant factors.

2. The "wide variation of results of the employment of different indices, already mentioned, impugns their accuracy as implements of

<sup>5</sup> 55 Sup. Ct. 894, *op. cit.*, at p. 901.

<sup>6</sup> *Ibid.*, pp. 896-97.

<sup>7</sup> *Idem*, p. 897.

appraisal."<sup>8</sup> The Court called attention to the 48 per cent spread between the highest and lowest of the indices used in finding the valuation.

3. The Commission weighted the several indices "upon a principle known only to itself, and thus rendered its process of valuation even more dubious and obscure."<sup>9</sup> The weight given to the index of Western Electric prices was especially criticized.

4. "A more fundamental defect in the Commission's method is that the result is affected by sudden shifts in price level. . . . A public service corporation ought not, therefore, in a rate proceeding, to be permitted to claim to the last dollar an increased value consequent upon a sudden and precipitate rise in spot prices of material or labor. No more ought the value attributable to its property to be depressed by a similar sudden decline in the price level."<sup>10</sup>

The majority found it necessary to consider the following pronouncement in the Los Angeles Gas and Electric Case:

The legislative discretion implied in the rate-making power necessarily extends to the entire legislative process, embracing the method used in reaching the legislative determination as well as that determination itself. We are not concerned with either, so long as constitutional limitations are not transgressed. When the legislative method is disclosed, it may have a definite bearing upon the validity of the result reached, but the judicial function does not go beyond the decision of the constitutional question. That question is whether the rates as fixed are confiscatory.<sup>11</sup>

The Court pointed out that this language had been used with respect to the claim that various elements of value had been ignored; that it was found, however, that though there may have been errors committed in this way they were neutralized by other allowances; and that nothing in this case justified the claim that the Court had departed from the principle announced in earlier decisions "as to the value upon which a utility is entitled to earn a reasonable return or the character of evidence relevant to that issue."<sup>12</sup>

Finally, the majority quoted with approval the following from *Northern Pacific Railway Company vs. Department of Public Works of State of Washington*:

But where rates found by a regulatory body to be compensatory are attacked as being confiscatory, courts may inquire into the method by which its conclusion was reached. An order based upon a finding made without evidence, (case cited), or upon a finding made upon evidence which clearly does not support it, (case cited), is an arbitrary act against which courts afford relief. The error under discussion was of this character. It was a denial of due process.<sup>13</sup>

<sup>8</sup> *Idem*, p. 897.

<sup>9</sup> *Idem*, p. 897.

<sup>10</sup> *Ibid.*, p. 898.

<sup>11</sup> *Los Angeles Gas and Electric Co. vs. Railroad Commission*, 289 U. S. 287, at p. 304 (1933).

<sup>12</sup> 55 Sup. Ct. 894, *op. cit.*, p. 899.

<sup>13</sup> 268 U. S. 39, p. 43 (1925). *Italics mine*.

Mr. Justice Stone wrote a minority opinion in which Justices Brandeis and Cardozo joined. The minority pointed out, first, that the sole issue is that of confiscation and that the Court did not pass upon that issue since it rejected the valuation fixed by the District Court. But since the decree of the lower court was nevertheless upheld the minority argued that the Commission's order was set aside upon a ground not raised upon the record or considered by the lower court, and that it was set aside because of being deemed a denial of due process in the procedural sense. The minority, however, could not see that any constitutional guarantees had been violated, saying:

The sole transgression, for which its painstaking work is set at naught, is that, in the exercise of the administrative judgment of this body "informed by experience" and "appointed by law" to deal with the very problem now presented, (case cited), it has relied upon a study of the historical cost and ascertained value of appellee's plant in the light of price indices, showing declines in prices, in arriving at the present fair value of the property, a procedure on which this Court has hitherto set the seal of its approval.<sup>14</sup> (citing cases).

After expressing "grave doubt" as to whether the  $4\frac{1}{2}$  per cent rate of return, which the rates ordered by the Commission would yield on the District Court's valuation, was confiscatory, Justice Stone proceeded to defend the use of index numbers in place of an appraisal in the present case by pointing out that an appraisal would have taken at least two years and would have cost the Company not less than \$300,000 and the State a very substantial sum. The Commission's weighting of the various component indices was also defended, it being pointed out that those indices which the Commission had reason to believe were more accurate and also those which were more directly applicable to telephone property were given the greatest weights. In answer to the majority's objection that the wide variation in the indices used impugned their accuracy as implements of appraisal attention was called to the fact that the results of the highest and lowest of the indices differed from the Commission average only by 10.6 per cent and 23.4 per cent respectively; that eleven of the sixteen indices separately considered gave results ranging between \$30,000,000 and \$34,600,000 as compared with the Commission average of \$32,610,327; and that in the New York Telephone Case, in which actual appraisals were used, the highest appraisal exceeded the lowest by 67.1 per cent. Justice Stone's further comments in defense of the use of index numbers in place of appraisals are of interest:

In assuming the task of determining judicially the present fair replacement value of the vast properties of public utilities, courts have been projected into the most speculative undertaking imposed upon them in the entire history of English jurisprudence. . . . When we arrive at a theoretical

<sup>14</sup> 55 Sup. Ct. 894, *op. cit.*, p. 900.



value based upon such uncertain and fugitive data we gain at best only an illusory certainty. No court can evolve from its inner consciousness the answer to the question whether the illusion of certainty will invariably be better supported by a study of the actual cost of the property adjusted to price trends, or by a study of the estimates of engineers based upon data which never have existed and never will. The value of such a study is a question of fact in each case, to be ascertained like any other in the light of the record, and with some regard to the expert knowledge and experience of the commission, which, in the present case, are obviously great.

So far as the results of the use of standard price indices is impugned by their variation, an examination of the present record will disclose that the results obtained by the application of price indices to the historical cost of plant are far less variable than engineers' valuations and in general are probably more trustworthy. . . . Present fair value at best is but an estimate. Historical cost appropriately adjusted by reasonable recognition of price trends appears to be quite as common sense a method of arriving at a present theoretical value as any other.<sup>15</sup>

By way of answer to the passage in the Northern Pacific Case<sup>16</sup> quoted with approval by the majority, Justice Stone quoted another passage from the same case, as follows:

The mere admission by an administrative tribunal of matter which under the rules of evidence applicable to judicial proceedings would be deemed incompetent (case cited), or mere error in reasoning upon evidence introduced, does not invalidate an order.<sup>17</sup>

Lastly, Justice Stone also quoted the passage from the Los Angeles Gas and Electric Case<sup>18</sup> which had been quoted by the majority, holding that the principle there announced should have been controlling in the case in question.

## II

In evaluating the respective merits of the foregoing majority and minority opinions it is necessary to begin with an analysis of the composite index used by the Commission. It is a fundamental principle recognized by economists and statisticians that procedure in constructing an index number (as regards such matters as choice of items, weighting, etc.) must be determined by reference to the *purpose* for which the index number is to be used, and that an index number constructed for one purpose is not valid or reliable if used for another.<sup>19</sup> The Commission's composite index presumably would be regarded by economists as an index of the general price level. Such an index is recognized as being of value as an approximate measure of changes in the general purchasing power of money. But it has been increasingly

<sup>15</sup> 55 U. S. 894, *op. cit.*, pp. 905-6.

<sup>16</sup> *Supra*, p. 248.

<sup>17</sup> 268 U. S. 39, *op. cit.*, at p. 44. (1925).

<sup>18</sup> *Supra*, p. 248.

<sup>19</sup> For example: "The choice of methods to be employed in making an index number should be guided by the purpose for which the results are to be used. These purposes are so numerous and so diverse that it is impossible to make a single series well adapted to them all." W. C. Mitchell, *The Making and Using of Index Numbers*, Bulletin 284, Bureau of Labor Statistics, p. 112.

recognized in recent years that an index of this sort obscures many diverse and significant movements in particular groups of prices, and that for many purposes it is these movements and their interrelationships which are significant.

It follows that a composite price index suitable for measuring changes in the general purchasing power of money could not properly be used to measure changes in the cost of reproducing a telephone property. The latter purpose requires an index based upon prices actually paid by telephone companies. Hence the writer believes that the majority were on sound ground both economically and legally in rejecting the valuation based upon the Commission's composite index. For what the Commission's figure really represented was not the cost of reproducing telephone property at all, but rather a revaluing of the original investment<sup>20</sup> according to changes in the general purchasing power of money between 1923 and 1932. In other words, in the language of economics, what the Commission computed was the Company's "real" investment in terms of 1932 dollars. This distinction would not exist if there were complete uniformity in price movements. But as matters actually stand the diversity of movement of individual prices and groups of prices is perhaps the central fact which appears from a study of the price structure.

Likewise it is the writer's understanding that the purchasing power of money in general is not one of the "values or elements of value" which according to previous decisions of the Court must be "considered" or "given weight" in arriving at value for rate-making purposes. To be sure, there have been numerous references to past and prospective movements of the price level, as, for example, in the *O'Fallon*<sup>21</sup> and *Indianapolis Water*<sup>22</sup> cases, but these references have generally borne on the question of the relative weight to be given to original and reproduction costs. Certainly, so far as the writer is aware, the purchasing power of money in general has not taken its place alongside original cost, reproduction cost, and other specific elements of value as a component in final valuations. In the writer's opinion the principal if not the only reason for the Court's action in this case may have been an objection to a valuation dominated by a factor which has not been recognized as an element of value, rather than an objection to the use of index numbers as a short cut in place of appraisals. Hence the Court's statement that an obvious objection

<sup>20</sup> More precisely, it was not the original investment which was revalued in this case but, as already indicated, the original investment increased by about \$6,000,000. However, this latter increase had been arrived at by the application of the Bureau of Labor Statistics wholesale price index to book cost. See *supra*, p. 247.

<sup>21</sup> *St. Louis and O'Fallon R. R. Co. et al. vs. U. S.*, 279, U. S. 461 (1929).

<sup>22</sup> *McCordle vs. Indianapolis Water Co.*, 272 U. S. 400 (1926).

to the indices was that they "were not prepared as an aid to the appraisal of property," but were "intended merely to indicate price trends."<sup>22</sup>

The minority imply that the majority opinion represents an improper extension of the scope of judicial review, in that in effect the Court substituted its judgment for that of the Commission on a straight question of fact—the wisdom and expediency of the weights given by the Commission to the components of its composite price index. Likewise, some writers apparently make the decision hinge largely on the majority's pronouncement that the Commission weighted the several indices "upon a principle known only to itself, and thus rendered its process of valuation even more dubious and obscure."<sup>24</sup> Dr. E. W. Morehouse has recently suggested what he regards as a way by which the Commission might have avoided reversal, as follows:

The point might be made that the weighting was merely a convenient tool used in exercising judgment as to value. It was not essential to that exercise of judgment. One wonders what the Court's opinion of the value judgment would have been if the separately trended values, stated without weights, had been used and the final value judgment expressed thereon. Would the Commission's judgment figure then have been impeached merely because trends had been examined in reaching a conclusion? Would the method in that event have been found faulty, and hence the result unconstitutional? . . . It is not clearly shown how the weighting process has impaired the Commission's judgment value.<sup>25</sup>

Commenting on the foregoing passage *Public Utilities Fortnightly* remarks editorially as follows:

After all, the majority opinion in the Maryland telephone case did not condemn the use of commodity indices by commissions but merely the erection of a mathematical rule of thumb that might seem to preclude the free play of individual judgment. Perhaps in the future, cases developed along this line that place emphasis upon the employment of judgment by the commissions in reaching their conclusions, may avoid the obstacle to such procedure set up by the Supreme Court in the Maryland telephone case. As it was, the Maryland commission succeeded in convincing three justices that its method was not necessarily confiscatory. Dr. Morehouse's suggestion might plausibly provide the margin of victory.<sup>26</sup>

While the foregoing suggestion is of unquestioned merit, in the opinion of the writer it does not touch the fundamental reason for the reversal. It was not a mere question of the right of the Commission to exercise its judgment as to using index numbers in place of an appraisal, or in the choice of, or weight to be given to, any index number *designed to measure reproduction cost or any other legally recognized element of value*. If such were the case the writer does not believe that

<sup>22</sup> *Supra*, p. 247.

<sup>23</sup> *Supra*, p. 248.

<sup>24</sup> E. W. Morehouse, "Price Trends in the Baltimore Telephone Case," *Journal of Land and Public Utility Economics*, XI, 318-19 (August, 1935).

<sup>25</sup> "Liberal Economists Deplore Maryland Telephone Decision," *Public Utilities Fortnightly* 446-49, 16, at pp. 448-49 (Sept. 26, 1935).

the majority opinion could be justified. The Commission, however, was overruled not because the foregoing questions were raised but because it avowedly and specifically was concerned with computing an index which would measure the Company's investment in terms of 1932 general purchasing power rather than an index of the cost of reproduction of telephone property, thus, to repeat, arriving at a valuation dominated by a factor which has not been legally recognized as an element in "fair value." This amounts, in the writer's opinion, to a mistake of law and a finding of fair value "upon evidence which clearly does not support it,"<sup>27</sup> and is an arbitrary act against which the Court properly afforded relief. The other objections raised by the majority, standing alone, would not likely, in the writer's opinion, have led to a reversal.

The Commission pointed out in its decision that the index numbers of the cost of telephone property submitted to it were, on the 1932 base, higher as of December 31, 1932, than they were during the years 1928-32, and about the same as during 1927. They tended to be high in periods in which incomes and the general price level were low and low when the latter were high. The Commission was obviously greatly disturbed by these vagaries in the behavior of cost of reproduction indices. It had felt obliged, in response to insistent public demand, to order a reduction in rates, and hence was virtually compelled to arrive at a valuation which would justify the reduction. The consequence was the scrapping of the reproduction cost concept and the adoption of the general purchasing power principle instead. These facts are clearly revealed in the following passage from the Commission's decision:

These numbers (indices of cost of reproduction of telephone property) indicate a situation so at variance with the experience of people generally not only of this country but of the world—a situation described by the Supreme Court as "a new experience to the present generation"—that this Commission feels that they cannot possibly show the actual present-day value of the company's property. For a relatively low value of the property would be obtained by using the index numbers shown in a time of high prices, 1929 for instance, while relatively high values would be found by using the index numbers given for years when prices were low. This also is contrary to the company's experience, for in 1924 it claimed a higher than cost value for its rate base because prices then were high. It seeks now a high rate base, and an increased rate of return, when prices are low.

Such claims do not seem reasonable to this Commission. . . . It is an unavoidable consequence of such a condition (the general fall in prices since 1929) that the fair value of a property employed in the public service and charged with a public interest should be subject to the general changes in the value of the dollar, and that its fair value must be less than the price which its books show was paid for it in times of higher prices; just as the value of the property was found by the court to be greater in 1924, when prices were high, than the books showed had been paid for it.

. . . . .

<sup>27</sup> See quotation from Northern Pacific Case, p. 248 *supra*.

It is apparent to the Commission that if the company were permitted now to earn the same rate of return allowed in 1924 and subsequent years upon a rate base equal to the value of property purchased since in years of high prices, *then its owners would actually profit by the world-wide depression which has, so generally, brought financial loss and distress to the rate-payers.* For while its stockholders would receive their dividends in the same number of dollars, they would get dollars of superior purchasing power. Their real return in bad times, therefore, would be greater than the return in good times, and the longer the depression continued, the greater would their harvest be.<sup>28</sup>

The following passage gives the District Court's answer to the foregoing contentions and is an admirable statement of the ground on which, in the writer's opinion, the Commission was finally overruled by the Supreme Court.<sup>29</sup>

It is apparent that the Commission in a general way was seeking to value the telephone property on the basis of an *average* trend of cost of materials, labor, and construction, but instead of taking an absolute average trend of all costs it took a so-called weighted average of only certain costs. The difference is, however, in our opinion, not of fundamental importance. In either case there is the essential fallacy of *assuming* that an *average trend of all prices*, whether absolute or weighted, is a true index for the trend of construction costs of the special kind of property with which we are here dealing. Whether the valuation of telephone property is based on historical cost or reproduction new, it is, we think, obvious that the price changes over a period of years can only fairly be reflected by developing a price ratio or trend for the costs entering into this particular kind of property. It is quite erroneous to assume that changes in the price level of certain commodities or the average of any number of commodities is similar to that of a particular commodity or property. . . . If this valuation method be used at all, we think it entirely clear that the only proper use is that adopted by the Company and not that used by the Commission; provided, of course, the cost data used by the Company represented fair and reasonable prices for telephone apparatus and construction work.<sup>30</sup>

For reasons sufficiently elaborated in the foregoing the writer believes that the opinion of the majority of the Supreme Court was correct in the light of the facts in this case. But, as stated at the outset, it is his opinion that the views of the minority are clearly preferable, both legally and economically, if in subsequent litigation it appears that this decision is to stand as a general condemnation of valuations involving the use of index numbers in place of appraisals. On the legal side, it seems to the writer that the wisdom or expediency of using index numbers, and the choice of, and weight to be given to, such numbers are questions of fact which under accepted legal principles

<sup>28</sup> *Re Chesapeake and Potomac Telephone Co. of Baltimore City*, 1 P.U.R. (New Series) 346, at pp. 352-53 (1934). Italics mine.

<sup>29</sup> The distinction between the cost of reproduction and general purchasing power concepts in connection with price indices has been recognized by several commissions: See *Re Coast Gas Co. (New Jersey)*, P.U.R. 1923A, 349, at pp. 353-57; *Re Bluefield Telephone Co. (West Virginia)*, P.U.R. 1926D, 209, at pp. 214-20; *Washington Heights Taxpayers Assn. vs. New York Edison Co. et al. (New York)*, P.U.R. 1932 E, 218, at p. 23; dissenting opinion in *Re The Ohio Bell Telephone Co. (Ohio)*, 2 P.U.R. (New Series) 113, at p. 165 (1934).

<sup>30</sup> *Chesapeake and Potomac Telephone Co. of Baltimore vs. Harold E. West et al., Constituting the Public Service Commission of Maryland*, 3 P.U.R. (New Series) 241, at p. 271 (1934). Italics are the Court's.

are not reviewable by courts.<sup>31</sup> On the economic side, it is likely that a considerable number of economists would agree with Justice Stone both as to the comparative accuracy of index numbers and appraisals in finding reproduction cost and as to the necessity of using the former device if there is to be economical and effective regulation in the present situation, in which reproduction cost is an important or even dominant element in the "fair value" which the commissions are required to find.<sup>32</sup> Concerning the limitations of appraisals, and affording striking support to Justice Stone's position, is the following by Messrs. Bauer and Gold:

The range of honest and competent differences may not be so great in some cases, but the processes of valuation are always involved with uncertainty as to fact. Appraisal consists extensively and inevitably of assumptions and guesses in planning and installation of properties which already exist and cannot be actually reproduced. *It deals<sup>33</sup> largely with theoretical quantities, hypothetical processes and assumed conditions, all determined by judgment of individual experts, instead of concrete facts capable of complete demonstration.* At best it is time-consuming, cumbersome, and expensive. The final determination, though sincerely made by commission, court or other fact-finding body, constitutes only a rough approximation, and not a fact that is definite and has been permanently established for administrative purposes. It is subject to litigation in the particular case, and soon thereafter when conditions have changed, may have to be determined anew.

The system leads inevitably to elaboration of detail, exaggeration of unimportant items, constant and useless wrangling, artificial and meticulous distinctions, excursions into immaterialities, stressing technicalities, and studied postponements, all at great expense and long delay to final but unconvulsive decision.<sup>34</sup>

As examples of the wide variations in the results of cost of reproduction appraisals may be mentioned the case of the Ohio Bell Telephone Company, where the figures ranged from \$104,282,735 to \$157,000,000; the Union Electric Light and Power Company of St. Louis, where the range was from \$40,000,000 to \$73,000,000; and the Worcester Electric Lighting Company, where the range was from \$9,000,000 to \$16,000,000.<sup>35</sup> Likewise, as illustrative of the delay and expense incurred in arriving at valuations involving such appraisals may be mentioned the New York Telephone Company Case, which extended over eleven years (1920-30) and cost the company alone over

<sup>31</sup> But see *Ohio Valley Water Co. vs. Ben Avon Borough*, 253 U. S. 287 (1920); *Crowell vs. Benson*, 285 U. S. 22 (1932).

<sup>32</sup> See W. A. Prendergast, *Public Utilities and the People* (Appleton-Century, 1933); C. O. Ruggles, "Some Aspects of Public Utility Rate Making," *Harvard Business Review*, 13, 417-34, (1935); W. J. Graham, *Public Utility Valuation—Reproduction Cost as Base for Depreciation and Rate Base Determination* (Monograph, 1934, University of Chicago Press); P. J. Raver, "Index Numbers of Public Utility Construction Costs," *Journal of Land and Public Utility Economics*, 3, 343-60 (November, 1927); F. G. Dorety, "The Function of Reproduction Cost in Public Utility Valuation and Rate Making," *Harvard Law Review*, 37, 173-200 (December, 1923); (with qualifications) Bauer and Gold, *Public Utility Valuation* (Macmillan, 1935).

<sup>33</sup> The word used in the original is "details."

<sup>34</sup> *Op. cit.*, pp. 376, 378. Italics mine.

<sup>35</sup> Mosher and Crawford, *Public Utility Regulation* (Harper and Brothers, 1933), p. 204.

\$5,000,000, and the Ohio Bell Telephone Company Case, which lasted ten years (1922-31).<sup>36</sup> Consequently one very important reason why rate control, which necessitates the finding of "fair value," has been rendered largely ineffective, and, in some cases may even be said to have gone by default, is the delay and expense involved in finding reproduction cost, which plays such an important part in the current "fair value" requirements of the Supreme Court.

On the other hand, several writers are skeptical as to whether the use of index numbers in place of appraisals would improve the situation as outlined above.<sup>37</sup> Their criticisms concern the accuracy and appropriateness of price data, the difficulty of taking into account changes in labor efficiency and in technology, and the like. It may be remarked in passing that these criticisms would apply to a majority of appraisals also. Certainly, however, few, if any, available indices achieve the standard which would be necessary for satisfactory application in the important task in question. The writer appreciates fully the difficulties and limitations of index numbers at their best. Nevertheless it is his opinion that reasonably satisfactory index numbers for use in place of appraisals can be constructed, and that the use of such indices is essential to the economical and effective administration of the current requirements for determining "fair value," in which reproduction cost is an important or even dominant element. This is not, of course, in any way to defend either reproduction cost or the current "fair value" requirements.

#### CONCLUSIONS

To sum up, in the writer's opinion, the majority of the Supreme Court in the case under review were on sound ground both legally and economically in reversing the Maryland Commission. On the legal side, it is the writer's view that the Commission was reversed because, while purporting to find the reproduction cost of the telephone company's property, it had in fact found the company's "real" investment in terms of 1932 dollars. Hence the resulting valuation was dominated by the factor of purchasing power of money in general, a factor which independently is not one of the "values or elements of value" which according to previous decisions of the Supreme Court must be "considered" or "given weight" in arriving at a proper valuation. On the economic side the majority showed insight in distinguishing between indices of the general price level and indices of the cost of reproduction

<sup>36</sup> *Ibid.*, pp. 205-6.

<sup>37</sup> *Ibid.*, pp. 212-13; George E. Goldthwaite, "Reproduction Cost and Falling Price Levels," *National Municipal Review*, 21, 427, at pp. 428-30 (July, 1932); E. C. Goddard, "The Evolution of Cost of Reproduction as the Rate Base," *Harvard Law Review*, 41, 584, at pp. 583-84 (March, 1928).

of telephone property, and in recognizing the diversity of movement shown by these indices.

On the other hand, in the writer's opinion, the minority were clearly correct in their contentions as to the relative accuracy of reproduction cost valuations arrived at by appraisals and by the use of index numbers, respectively, and as to the necessity of using the index number method if there is to be economical and effective regulation in the present situation, in which reproduction cost is an important or even dominant element in the "fair value" which commissions are required to find. The writer believes that the majority were correct in the light of the facts in this case, but that it would be unfortunate if in subsequent litigation it should appear that the Court intends this decision to stand as a general condemnation of valuations arrived at by the use of index numbers in place of appraisals. If the view of the writer, as to the reason for the decision in this case, is correct, this last is not the Court's intention.



## DISTINCTIVE CONCEPTS OF PRICE AND PURCHASING-POWER INDEX NUMBERS

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THE USUAL method of measuring changes in the value of money or its purchasing power is to use the reciprocal of the index of the general price level, regarding the value of money as simply the inverse of prices. This usage has apparently followed from the obvious relation between money and goods in the case of a single commodity. If the price of an article doubles, a given amount of money will buy only one-half as much of it; the change in the purchasing-power of money over a given commodity is merely the inverse or the reciprocal of the change in its price. It has been accepted without question that the same principle applies to a composite unit of many commodities, and that an index of the prices of such a group satisfactorily measures (inversely) the value of money as applied to these commodities. It is the purpose of this paper to examine the validity of this transfer of principle. Instead of there being just one problem having two reciprocal aspects, we envision two related but different problems. A price index attacks the relationship of a given composite unit of goods to a varying amount of money; a purchasing-power index attacks the relation of a given amount of money to a varying amount of the composite unit of commodities. The distinction will appear in the weighting systems which are used and the implicit assumptions made when these weights are applied in mathematical formulas.

The discussion concerning index number technique has turned mainly on the selection of data and the algebraic characteristics of various formulas, with insufficient attention being given to the fundamental nature of the phenomena dealt with. Such discussion of methodology is futile unless agreement can be reached as to the purposes to be served. Conversely, a clear conception of the phenomena being studied will usually go far toward solving the problem of technique. These statistical problems should be attacked from the standpoint of the economic principles involved as well as, and precedent to, an examination of the mathematical qualities of index number formulas. We propose to examine in detail the economic nature of the phenomena of prices and money and to measure these characteristics up against the algebraic properties of index number formulas.

Before attacking the problem of purchasing-power index numbers, we must first clarify certain basic concepts of price indexes. Our starting-point may well be Bowley's classic definition:

Index-numbers are used to measure the change in some quantity which we cannot observe directly, which we know to have a definite influence on many other quantities which we can so observe, tending to increase all or diminish all, while this influence is concealed by the action of many causes affecting the separate quantities in various ways.<sup>1</sup>

What Bowley apparently has in mind is an index of the general purchasing power of money—the field in which index numbers were first employed. Several ideas are implicit in this definition: first, that there is a single real and definite phenomenon or value which it is sought to measure.<sup>2</sup> It may be questioned, however, whether any such definite force always exists, whose nature and magnitude it is sought to determine by observing its multiple influences on measurable phenomena. Does an index of the physical volume of production in agriculture or industry have any such connotation of a single central force? It might be answered that “prosperity” is this ultimate object of measurement; but the reply is that this is not a single *force* exerting a uniform influence on many measurable quantities, but is an abstract *resultant* of many diverse forces. It is true that there must always be some unifying idea governing the selection of data to answer the requirement of homogeneity, but Bowley had something much more definite in mind.

In this connection it should be remembered that statisticians recognize two kinds of average, abstract and concrete, or in Jevons' words, fictitious and precise. Abstract or fictitious averages are pure fictions of the imagination—convenient abstractions invented to serve certain functions of summarization and comparison. The average wage of workers in a factory, the average weight of the players on a football team, illustrate this type of average. There is no reality corresponding to the figure for wage or weight obtained by the mathematical process of averaging. If, on the other hand, repeated measurements are made by one or more investigators of the magnitude of an angle, the distance to the moon or the mass of an object in the laboratory, the average of the successive observations is our best estimate of the true magnitude—it represents an actual, real, concrete, existing fact. Now, the theory underlying the choice of method in computing an average depends,

<sup>1</sup> Arthur L. Bowley, *Elements of Statistics*, 3rd ed., p. 217.

<sup>2</sup> Compare C. M. Walsh, *The Measurement of General Exchange Value*, Chap. III, especially pp. 54-67.

among other things, on the nature of the phenomena being averaged, as regards these considerations. In the latter case the theory of errors applies strictly; in the former it applies only by empirical demonstration of analogy.

Bowley's definition obviously regards index numbers as being concrete or real averages, and a long line of students from the time of Jevons have accepted this position and have based their theory of method and technique on this premise.<sup>3</sup> By explicit statement and by direct reference to physical analogy they have defined the problem of an index of the value of money as being of the same nature as the problem of averaging repeated measurements of a physical quantity. They regard price indexes as measuring the definite and uniform influence of monetary changes on all prices, segregated or extracted from the divergent "demand and supply" influences affecting individual commodities.

From this view of the economic nature of the problem of price indexes flow important consequences. Only by such a concept can a search be justified for a "universal" or an "ideal" index number formula, judging perfection by purely mathematical tests.<sup>4</sup> From this view, again, Edgeworth formulated two principles of construction; first, that an index number of the value of money should be unweighted, for each price quotation is an independent "observation" of the basic phenomenon and thus has as much importance as any other, regardless of the volume of trade or consumption of the article.<sup>5</sup> Secondly, he concluded, the proper average to be employed is the median, in order to reduce the influence of those items deviating widely from the central values, thus indicating less reliability as an observation of the real phenomenon, monetary causes of price changes.

A second implication of Bowley's definition is that index numbers involve a sampling process among the "other quantities which we can [directly] observe." Thus it is only necessary to design the methods of construction so as to conform to the mathematical theory of sampling to assure an accurate measurement of the movement of prices and the value of money.

<sup>3</sup> Jevons, Edgeworth, Hawtrey, Flux, March and Gini. See W. Stanley Jevons, "The Variation of Prices and the Value of the Currency since 1782," in *Investigations in Currency and Finance*, 2nd ed., p. 114; F. Y. Edgeworth, "Some New Methods of Measuring Variation in General Prices," *Journal of the Royal Statistical Society*, vol. 51 (1888), p. 348, and numerous other references; R. G. Hawtrey, "Money and Index Numbers," *idem*, vol. 93 (1930), p. 65; A. W. Flux, "The Measurement of Price Changes," *idem*, vol. 84 (1921), pp. 178-179; Lucien March, *Mouvement des Prix et des Salaires pendant la Guerre*, pp. 11, 13; Corrado Gini, "Quelques Considérations au Sujet de la Construction des Nombres Indices des Prix et des Questions Analogues," *Metron*, vol. 4 (1924), p. 15. See also Bowley, "The Measurement of Changes in the Cost of Living," *Journal of the Royal Statistical Society*, vol. 82 (1919), p. 345.

<sup>4</sup> Reference is made to Walsh's "universal" formula, *op. cit.*, pp. 375, 376, and to Fisher's "ideal" formula, *The Making of Index Numbers*, e.g., p. 220.

<sup>5</sup> *Memorandum of the British Association for the Advancement of Science*, 1889, p. 187.

## II

This point of view is logical, if the premises be granted. It is submitted, however, that an entirely different view must be taken of the problem of price and purchasing-power indexes. It is our contention, first, that neither are individual prices and price changes independent phenomena, nor is their selection for inclusion in an index number made at random. It would seem that these statements need only to be brought to the attention of economists to receive acceptance. The first, that all prices are interdependent, has long been an axiom of economic theory, because of the fundamental principles of scarcity and substitution, and because economic value (of which "price" is a special case) means *exchange* value, a purely relative concept. As to the random character of various prices, we are certainly not justified in assuming that the divergent demand and supply changes of individual commodities occur without reference to their popularity. We cannot assume that the dispersion of the relatives around the median is random and independent of the positions the commodities occupy in the economic system, for this dispersion is caused, even according to the viewpoint taken by the authors referred to, by the individual demand and supply conditions of the commodities. But changes in the demand and supply conditions of one commodity are quite likely to be correlated with such changes in related commodities.<sup>6</sup> As to their sampling selection, it is obvious that the primary consideration for the selection of commodities, both in the past and at present, is the availability of the data on their prices. This selection naturally leans strongly in the direction of the commoner commodities, and violates the criterion of randomness.

A third objection, of less theoretical importance, is the question as to whether, in actual practice, we commonly have a large enough sample to depend on the theory of errors. By the theory of the purchasing power of money over commodities weighted according to their actual importance, a relatively small sample of judiciously selected goods may be quite representative; but it requires a much larger sample, by the theory of errors, to reach the condition where "The rope is much stronger than its component strands."<sup>7</sup>

We would raise a still more fundamental question, however, regarding this view of price indexes. These students explicitly seek in such an index a measure of the *uniform* influence on prices exerted by

<sup>6</sup> Compare Bowley, "The Influence on the Precision of Index-Numbers of Correlation between the Prices of Commodities," *Journal of the Royal Statistical Society*, vol. 89 (1926), pp. 300-319; and Edgeworth, *idem*, vol. 88 (1925), pp. 564, 570, note. While recognizing some relationship between prices, it appears that these scholars underestimated its degree or importance in the theory.

<sup>7</sup> Edgeworth, "Mr. Walsh on the Measurement of General Exchange Value," *Economic Journal*, vol. 11 (1901), p. 409.

changes in money, unaffected by the diverse price changes caused by the sundry demand or supply changes of individual commodities. Without any attempt to survey the whole of the broad field of monetary theory and the problems of stabilization implied, we question whether there is, *even in theory*, any such uniform monetary influence.<sup>8</sup> Consider, first, how a "monetary" cause actually works. Theorists have often carelessly assumed that if everyone suddenly awoke some morning with double the money previously possessed, the prices of all commodities would immediately and uniformly double. We see no justification for such an assumption: for one thing, it ignores all contractual relations. Such a view was not held by the originator of the illustration, John Stuart Mill. Mill claimed only that after a sufficient lapse of time to allow for adjustments to be made, "general prices" would respond as *a whole* exactly in proportion to changes in the supply of money, other things being equal.<sup>9</sup> He explicitly stated that the immediate effects on various prices would be quite different. Prices are set solely and exclusively by individual demand and supply conditions, and change variously, even in response to a single stimulus such as inflation, as the people of a society amend their purchasing habits. Differing elasticities of demand and differing stabilities<sup>10</sup> of demand (as well as of supply) connote that as the collective purchasing power of a community changes, prices of various commodities react in quite diverse manners. Even taking the clearest case of a "monetary cause," paper money inflation, the paper money originates in the hands of a particular purchaser, the government, and the inflationary tendency works first through the demand for the commodities and services required by the government. The monetary cause itself *upsets the equilibrium* of the demand for the various types of goods, instead of exerting a uniform influence on all prices.

This leads us to quite a different concept of price and purchasing-power index numbers. Rather than initial changes in the value of money influencing all prices uniformly (and then these individual prices being further modified and masked by changes in their diverse demand and supply factors), actually the changes in the demand and supply relations of individual commodities, and thus their prices, are the only real phenomena that exist, even in theory. There *is* no change in the value of money except that which is the result of, or rather is

<sup>8</sup> Compare J. M. Keynes, *A Treatise on Money*, vol. I, Chap. 6, entitled, "Is there such a thing as an 'Objective Mean Variation of General Prices'?"; Gottfried Haberler, *Der Sinn der Indexpzahlen*, pp. 73-76, "Der Geldwertbegriff. Monismus und Pluralismus in der Indextheorie."

<sup>9</sup> *Principles of Political Economy*, Ashley ed., pp. 492, 493.

<sup>10</sup> By stability of demand is meant the tendency for the demand schedule for a commodity to remain relatively constant and unchanging over time. Thus the demand for eggs may be stable, though elastic, while the demand for brown silk stockings may be unstable, although conceivably inelastic.

composed of, changes in the prices of commodities. In theory as well as in practice the value of money is merely the abstract summary statement of its purchasing power over specified commodities and services.<sup>11</sup> Changes in the value of money are merely summarized, by averaging in some appropriate manner the observed changes in its purchasing power over these individual commodities and services—their prices. Since we can no longer regard different prices as independent or random observations of a single real phenomenon, we cannot justify the use of an unweighted average. On the contrary the summary expression of the purchasing power of money must take equal account of all transactions: in other words, each price must be weighted by its proper volume of trade.

Since these indexes are abstractions, it is obvious that there can be no objective test for judging what mathematical formula gives the correct and accurate result in measuring, for example, the value of money. Our inquiry concerning a method must not be, "Is it correct?" but "Is the abstract concept thus defined and measured a useful concept, in accordance with the economic characteristics of the phenomenon under discussion, and thus applicable to the purpose in hand?"<sup>12</sup> Just what are the distinctive characteristics of purchasing-power indexes?

### III

Prices, being money ratios, have several aspects, corresponding to the different functions performed by money. We are not here interested in the physical use of money as a medium of exchange: it is the economic aspects of money which claim our attention. On the one hand money serves as a standard of value or a measure of value; on the other hand we may note its function as a standard of deferred payments and a storehouse of value. Prices as measures of value serve merely as a convenient method of comparing values—a suit of clothes is worth \$22.50, shoes \$8 a pair and bread \$.07 a loaf, etc., instead of a suit being worth 2.82 pairs of shoes or 321 loaves of bread, a pair of shoes worth .355 suits or 114 loaves, etc., *ad infinitum*, the value of each being quoted in terms of all the others. No element of time is involved in this use of prices for comparing values. When we come to the other uses of money, however, stating a debt (or deferred payment) in terms of money, or laying aside money against a rainy day,<sup>13</sup> there

<sup>11</sup> Compare Gottfried Haberler, "A New Index Number and its Meaning," *Quarterly Journal of Economics*, vol. 42 (1927-28), p. 435.

<sup>12</sup> Compare the point of view of Willford I. King in his *Index Numbers Elucidated*.

<sup>13</sup> Money thus hoarded can be regarded as a special case of a debt or deferred payment—a debt by society to the saver: a note signed by society rather than by an individual. These two functions of money can therefore be subsumed under the first, a standard of deferred payments. Contrast the treatment of the "standard of deferred payments" by Haberler, *op. cit.*, p. 441.

are other more complicated aspects of money which must be recognized—the buying power of money. In the former instance money serves merely to facilitate the statement of a set of *instantaneous* value relationships; in the latter cases money serves to define and record composite values *over periods of time*.

The writers on monetary problems have always assumed, either implicitly or explicitly, that the problem of the purchasing power of money is identical with the problem of the price level: that an index of the value of money is universally equivalent to the reciprocal of a price index. Thus Edgeworth introduced an article on index numbers with the statement, "Index numbers are used to indicate changes in the value of money."<sup>14</sup> Bowley's definition of an index number previously quoted implies the same: it is a change in the value of money which constitutes the "quantity which we cannot observe directly, which we know to have a definite influence on many other quantities [prices] which we can so observe." Irving Fisher gives perhaps the most explicit statement:

The purchasing power of money is indicated by the quantities of other goods which a given quantity of money will buy. . . . In short, the purchasing power of money is the reciprocal of the level of prices; so that the study of the purchasing power of money is identical with the study of price levels.<sup>15</sup>

Even though there is this obvious and intimate relation between prices and the value of money, it is our contention that nevertheless the two are not identical, either in meaning or in the technique of measurement. There have been in the past, in fact, a few scattered and hesitant suggestions of a possible differentiation between these two problems. A. W. Flux wrote in 1907,

There are two important questions to which one might expect to find the answer in the indications of a well-devised and carefully kept index-number. The one is, "What is the change in the money-cost of the things we buy, due to price-changes since any given date in the past?" The second is, "What is the average change in the value of money relative to other things since any given date in the past?" In one sense these are but two forms of one question. But in another sense they are different. The first presents a concrete problem: given a certain mass of commodities, what should they cost, or in what proportions would their cost vary, at different times? It will be readily seen that this differs substantially from the question of how price variations affect the cost of living. The former question ignores, the latter should distinctly include, considerations relating to the changes in standards of living which are developing.<sup>16</sup>

In this quotation Flux goes right up to the threshold of the distinc-

<sup>14</sup> Palgrave's *Dictionary of Political Economy*, vol. II, p. 384.

<sup>15</sup> *The Purchasing Power of Money*, pp. 13, 14. Compare also Walsh, *op. cit.*, pp. 253, 375, 376, and his *The Problem of Estimation*, p. 116; Carl Snyder, *ibid.*, p. 189; Sir Geo. H. Knibbs, *Journal of the American Statistical Association*, Vol. 19 (1924), pp. 200, 201, and *Price Indexes, their Nature and Limitations, the Technique of Computing them, and their Application in Ascertaining the Purchasing-Power of Money*, p. 1.

<sup>16</sup> "Modes of Constructing Index Numbers," *Quarterly Journal of Economics*, vol. 21 (1906-07), pp. 620, 621.

tion, and then does not take the final step. Instead, he implies first that a single "well-devised index number" should answer both questions, although later he seems to realize there must be two formulas, one to ignore, and the other to include changes in the standard of living. However, the most serious deficiency of Flux's analysis is that the distinction he thus makes between the indexes does not coincide with nor answer the two questions he has set up. The difference between price and purchasing-power indexes is not that between fixed and changing standards of living.

The distinction we make between price and purchasing-power indexes rests on another basis. Allyn Young glimpsed the solution in 1921 in his "Measurement of Changes of the General Price Level":

With constant weighting  $\Sigma(t)$  [physical quantities] is constant, and the index numbers express merely the fluctuations of  $\Sigma(m)$  [total value]. In this form index numbers of the general price level are the "weighted sums" which several recent writers have ranked among the better index numbers, and which have proved themselves serviceable in practice. But though free from some of the defects of other familiar types of index numbers, these weighted sums are not wholly satisfactory expressions of the general price level. They indicate merely the varying amounts of money payments required by sales of constant quantities of goods at prices determined in part by the condition that such sales have not in fact been constant. Or with other weights than  $t$  [quantities], they may indicate the changing market value of a constant volume of production, or the changing cost of a fixed bill of goods or of a fixed standard of living.

Another sort of weighted sum is possible. If  $\Sigma(m)$  [total value] and its constituent parts are treated as constants  $\Sigma(t)$  [total quantities] would serve as a weighted sum. Its variations would show the fluctuations in the volume of goods that would be sold under the condition that constant amounts of money are assigned to the purchase of each commodity at prices determined in part by the condition that money payments are not, in fact, constant.

The two different types of weighted sums give different, and inconsistent, index numbers. There is no reason to prefer one to the other as an index of the "general level of prices." For this purpose neither is satisfactory. Each has its own significance, but this significance lies in the particular meaning determined by the method of construction. Paucity of data makes the second type impracticable except for the study of limited fields of production, consumption, and trade. But it has a better right than the other to be considered an index of the "purchasing power of money."<sup>17</sup>

In the last sentence of this quotation Young found the secret, we believe, of a purchasing-power index. He did not, however, follow up the analysis or support his viewpoint. In a later writing, in fact, Young reversed his position:

It has sometimes been urged that the harmonic average is the proper measure of a change of the *purchasing power* of money, since purchasing power is the reciprocal of price, and a change of price is accompanied by an inverse change of purchasing power. The point is not sound. A change in price is an inverse change in purchasing power. In a properly constructed index number it should be a matter of indifference whether price changes or their reciprocals are the component units. But the harmonic average does not agree with the arithmetic average. It uniformly gives a smaller result. A glance at its formula will show that the harmonic average of relatives is

<sup>17</sup> *Quarterly Journal of Economics*, vol. 35 (1920-21), pp. 569, 570.



the reciprocal of the arithmetic average with the base shifted to the other of the two years involved in the comparison. It has the same type of biased error as the arithmetic average, but its error is in the opposite direction. In general, therefore, what has been said of the arithmetic average holds, *mutatis mutandis*, for the harmonic average. For example, just as the arithmetic average exaggerates a general rise of prices so the harmonic average understates it.<sup>18</sup>

We believe Young confused several ideas in this passage. He ignored his former reasoning with regard to the differing weighting systems appropriate to the two indexes, in favor of a purely algebraic approach and a judgment based on ideas of "biased" results. Denouncing both the arithmetic and harmonic averages as having "biased error" begs the question as we are considering it on its economic merits.

#### IV

As stated by Fisher in the definition quoted above, the purchasing power of money implies "the quantities of other goods which a given quantity of money will buy." *Changes* in this purchasing power, then, would be indicated by the changing quantities of other goods which the same *given quantity* of money will buy. It is to be demonstrated that this does not agree, as is generally assumed, with the reciprocal of the price index. The price index measures how much money is needed at successive times to purchase *the same quantity of a bill of goods*.<sup>19</sup> Its reciprocal is not identical with the true purchasing power of money because a different assumption is implicit as to the weighting system used.

One of the series which it is agreed must be prominent in an index of the general price level is the index of wholesale prices. This will be employed to illustrate the contention here made, namely that what is needed to measure changes in the purchasing power of money is *not* the reciprocal of an index of prices, but *an index of the reciprocals of prices*, properly weighted.<sup>20</sup>

The *price* index weights the various commodities in accordance with the relative quantities used at a given time (usually the base year or

<sup>18</sup> Chapter on "Index Numbers," in *Handbook of Mathematical Statistics*, H. L. Riets, editor-in-chief p. 185.

<sup>19</sup> This statement would seem at first sight to require a slight modification in the case of double-weighted formulas, such as the so-called "ideal" formula. In this case two different "bills of goods" appear to be used. But Persons has shown in Chapter II of his *The Construction of Index Numbers* that the "ideal" formula in effect employs a constant average bill of goods. Our criticism thus applies strictly, without modification.

<sup>20</sup> Many perplexing problems enter into the determination of the index of this general price level; what commodities and services should be included, what prices (wholesale, retail or both) should be used and in what proportions, and whether wage rates, interest rates and security prices should be included. It is not our purpose to discuss all of these questions, but to concentrate attention on one problem—the weights which should be employed for the various elemental series, and the manner in which these weights should be applied in the formula. For the other problems refer, e.g., to Carl Snyder, "A New Index of the General Price Level from 1875," *Journal of the American Statistical Association*, Vol. 19 (1924), pp. 189–195. See also C. M. Walsh, *The Measurement of General Exchange Value*, Chap IV, pp. 76–135; Haberler, "A New Index Number and its Meaning," *op. cit.*

the average of several years), keeping these *quantities* constant as the prices of the commodities vary.<sup>21</sup> Thus, as time passes, more relative importance (in the budget) is given to those commodities whose prices have increased, and less importance to those commodities whose prices have decreased. Let this be illustrated by the data in Table I, part 1. For convenience, only two commodities are considered, and equal weights are given them—one unit of each being purchased each month. Note, furthermore, that in each month the price changes are assumed to be of opposite direction but of the *same percentage amount*.

TABLE I  
COMPUTATION OF PRICE INDEX AND PURCHASING-POWER INDEX  
(Data hypothetical)

1. Price Index							
Com- modity	Price (Dollars per Unit) in				Percentage Changes		
	January	February	March	April	J to F	F to M	M to A
A	\$1.00	\$1.20	\$1.08	\$1.241	+20	-10	+15
B	1.00	.80	.88	.748	-20	+10	-15
Both	\$2.00	\$2.00	\$1.96	\$1.989			
(Recipro- cals)	100 (base)	100	102.1	100.5			
2. Purchasing-Power Index							
Commodity	Price (Units per Dollar) in						
	January	February	March	April			
A	1 unit	.834 units	.926 units	.806 units			
B	1 unit	1.250 units	1.137 units	1.336 units			
Both	2 units	2.084 units	2.063 units	2.142 units			
Index	100 (base)	104.2	103.2	107.1			
3. Comparison of Results							
	January	February	March	April			
Pseudo Purchasing-Power Index:	100	100	102.1	100.5			
True Purchasing-Power Index:	100	104.2	103.2	107.1			

Let us notice the behavior of the index of the prices of these two commodities. During the first period of change, January to February, the equal but opposite 20 per cent changes just balance, resulting in an unchanged index. This is true because the two commodities were actually of equal importance at the beginning of the change. Thereafter, however, since commodity A remains higher priced, equal but opposite percentage changes in price do *not* leave the index unchanged, but it moves in the direction of the prices of commodity A, which, being more expensive, really is given more weight and thus dominates the index. Equal original weights of one unit each do not actually result in an equally weighted index number system, but one biased in the direction of the price changes of the commodity or commodities which

<sup>21</sup> That this statement is true even though so-called value-weights are used, is evident when it is remembered that the weighted aggregative and weighted arithmetic-average-of-relatives index formulas give identical results when base year quantities and values are used as weights.

have become relatively more expensive. This index is an index of the *prices* of equal *quantities* of the two commodities, rather than (the inverse of) an index of the purchasing power of money.

Now let us compute a *true* index for the purchasing power of money, assuming exactly the same data on prices, but expressing these prices in amounts obtainable for a dollar. (See Table I, part 2.) In this case we still give the two commodities equal weight, but we *keep* them weighted equally in the sense of spending a dollar for each in each month. Our index must measure how much we get for our money. Let us assume temporarily for convenience that the quantity units are homogeneous—a pound in each case. Noting the results in part 3 of the table, we see that the true change in the purchasing power of money from February to March is  $-.9$  per cent instead of  $+2.1$  per cent, and from March to April is  $+3.8$  per cent instead of  $-1.5$  per cent as indicated by the reciprocal of the price-index.

It is evident that this difference arises from the different weights applied by the formulas despite our proposed intention of maintaining equal weights. The price index gives more weight to the price changes of the expensive article *A* by assuming constant *quantities* to be bought, while the purchasing-power index gives more weight to the price changes in the cheaper article *B*, by assuming constant *expenditure* to be maintained. Now the obvious and simple implication of the term "an index of the purchasing power of money" is the literal meaning of its power to purchase—how much of other commodities in general a given unit of money will exchange for. If we are measuring changes in its buying power over several commodities, we must thus measure the changing quantities of these commodities when the *same amounts of money* are paid for them respectively, rather than measuring the varying total cost of the same respective quantities.

The formula for the above unweighted, or equal-weighted index of purchasing power may be written as follows, using the notation of  $p$  for price in terms of dollars per unit,  $u$  (equals  $1/p$ ) for price stated as units per dollar, zero subscripts for base year, and "one" subscripts for given year prices in either form:

$$\text{Unweighted Purchasing-Power Index} = \frac{\sum u_1}{\sum u_0} = \frac{\sum 1/p_1}{\sum 1/p_0}. \quad (1)$$

Let us now examine the construction of the *weighted* index of the purchasing power of money. It is noted in the example given above that the two commodities were equally weighted not only in the sense of the same quantities being used in the base year, but also in the sense of the same value. This limitation must be removed. Further-

more, in actual practice, adjustment must be allowed for non-homogeneous units, yards, tons, quarts, etc. The problem in Table II will illustrate all of these points.

TABLE II  
COMPUTATION OF PRICE INDEX—UNEQUAL WEIGHTS  
(Data hypothetical)

Commodity	Quantity used per month in 1925 $q_0$	Price: dollars per unit		Value in 1925 $v_0$
		1925 $p_0$	1926 $p_1$	
Butter	10 lbs.	\$ .50	\$1.00	\$5.00
Milk	50 qts.	.10	.20	5.00
Coal	50 lbs.	.02	.01	1.00
Cloth	10 yds.	.10	.05	1.00

To calculate the purchasing-power index, let us first change the form of the prices to the form of units per dollar. These are shown in the second and third columns ( $u_0$  and  $u_1$ ) of Table III.

TABLE III  
COMPUTATION OF PURCHASING-POWER INDEX—DATA IDENTICAL  
WITH TABLE II

	Price: units per dollar in		Weights $v_0$ $u_0$	Weighted quantities per dollar in	
	1925 $u_0$	1926 $u_1$		1925 $\frac{v_0}{u_0} \cdot u_0$	1926 $\frac{v_0}{u_0} \cdot u_1$
Butter	2 lbs.	1 lb.	2.50	5.0	2.5
Milk	10 qts.	5 qts.	.50	5.0	2.5
Coal	50 lbs.	100 lbs.	.02	1.0	2.0
Cloth	10 yds.	20 yds.	.10	1.0	2.0
				12.0	9.0

Now it is evident from the "value in 1925" column in Table II that the first two commodities, butter and milk, must be given the same relative weight, and five times the weight given each of the last two articles, reflecting the relative purchasing power expended on them in the base year, 1925. But these weights of 5, 5, 1, and 1 cannot be used directly, for a modifying or adjusting weight must be introduced to correct for the relative size of the physical unit employed in the  $u$ 's. Specifically, we cannot weight 2 lbs. of butter and 10 qts. of milk (to the dollar) by 5 each, and get a correct result: suppose we called the 10 qts. of milk 20 pts.; then this arbitrary choice of units would entirely change the index. Similarly tons might as logically (perhaps more so) be used to measure the price of coal: a pound of coal has an entirely different significance from a pound of butter. A perfect corrective factor for the weights is the price (dollars per unit) in the base year,  $p_0$ , or  $1/u_0$ . The complete weights are, then,  $v_0/u_0$ , which give an

accurate measure of the importance of the commodities when their prices are stated in  $u$ 's—so many units to the dollar.

From Table III it is evident that the Index of the Purchasing Power of Money for 1926, relative to 1925 is  $9.0/12.0=75$  per cent.<sup>22</sup> The formula for this true index of the value of money follows: the quantities in the parentheses in the first fraction represent the weights applied to the prices—prices in the form of units per dollar:

$$\frac{\sum (v_0/u_0)u_1}{\sum (v_0/u_0)u_0} = \frac{\sum (u_1/u_0)v_0}{\sum v_0}. \quad (2)$$

This will readily be recognized as a weighted arithmetic average-of-relatives index, using base year value weights ( $v_0$ ). As is obvious in the second fraction, the relatives represent, as desired in a purchasing-power index, the amounts purchasable for \$1 in the given year, relative to the base year ( $u_1/u_0$ ).

For convenience in using the purchasing-power formula for prices stated in the usual manner of dollars per unit ( $p$ 's), we may state the formula in the following form:

$$\frac{\sum (u_1/u_0)v_0}{\sum v_0} = 1 / \left( \frac{\sum v_0}{\sum (p_0/p_1)v_0} \right). \quad (3)$$

This form of the index is especially interesting, as it introduces a second method of viewing the whole matter of formula and weights: this purchasing-power index is simply the inverse or reciprocal of the weighted *harmonic* mean of prices in their usual form. Let us examine the problem from this point of view.

As the writer has shown in another place,<sup>23</sup> the principal use of the harmonic mean is in certain cases of averaging rates or ratios. Ratios may always be stated in two forms, keeping one or the other of the factors constant (e.g., cents per *pound*, or pounds per *dollar*). The conditions of the problem for which an average is sought will determine which of the factors *should* be kept constant (whether in the two periods weights are to be constant in the sense of equal *quantities* bought or of equal *dollars* spent on each commodity). If it is desired to keep constant that factor which *is* constant in the rates as stated, then the arithmetic mean should be used; if, on the contrary, the

<sup>22</sup> For comparison, it may be noted that the *price* index 1926/1925 equals 175 per cent, and the pseudo-index of purchasing power, its reciprocal, equals 57.1 (compared with the true index of 75). It is obvious that the price changes here assumed are extreme—that this example exaggerates the differences which would ordinarily be found in practice.

<sup>23</sup> "The Nature and Use of the Harmonic Mean," *Journal of the American Statistical Association*, Vol. 26 (1931), pp. 36-40.

recorded rates (prices) make variable the factor desired to be constant, then the harmonic mean is the correct average to be employed. Accepting the ordinary method of stating prices as dollars per unit, if we desire to maintain constant relative expenditure, the use of the harmonic mean of price relatives is thus indicated. Taking base year expenditures (values) as weights, the formula is, for the weighted harmonic "price" index,

$$\frac{\sum v_0}{\sum v_0/(p_1/p_0)} = \frac{\sum v_0}{\sum (p_0/p_1)v_0}. \quad (4)$$

This is seen to be the reciprocal of the true purchasing-power index found above and given in formula (3).

Our position is, then, that a purchasing-power-of-money index must be so calculated that the proportional *expenditure* on the various commodities is maintained, rather than assuming constant *quantities* purchased. What is the practical significance of this concept? It has a definite meaning, distinct from the usual implication of a purchasing-power index as merely an inverse method of stating price changes. The difference lies in the several functions of money previously referred to. People using money simply as a standard of value and a medium of exchange are interested in *prices* as such. To manufacturers and merchants engaged in the fabrication and trading of goods and services (aside from the obtaining or granting of credit), prices are of interest and importance merely as statements of comparative values at the time—money as a standard of value with no element of speculation. When we pass to the use of money as the standard of deferred payments, however, we are interested in individual prices only as they inversely measure the profit or loss from the speculative<sup>24</sup> transactions involved—the increase or decrease in the purchasing power of money. When long-time contracts are considered, when debt repayments, savings and fixed incomes are the subject-matter, it is the purchasing power of a *given sum* which is directly of interest—the *variations in the amount of goods* the money will buy. Since this measure differs (as the harmonic from the arithmetic mean) from the inverse of the measure of the varying amount of money needed to buy a given quantity of goods, it is evident a choice must be made between the two means—between the two weighting systems implicit in the two averages.

<sup>24</sup> The word "speculative" is here used in its broadest meaning. All time-spanning ownership of property involves speculation—either speculation in an individual commodity or, in the case of the ownership of money, speculation in *all* commodities.

The two uses of money seem to give the clue for the decision. A price index must measure the varying amounts needed to buy a fixed inventory of goods (necessitating the use of the arithmetic mean of ordinary price relatives); a purchasing-power index must measure the varying amounts of goods (in a given monetary proportion to each other) purchasable with a fixed amount of money. It is only the weighted *harmonic* mean of ordinary price relatives whose reciprocal measures the true purchasing power of money.

# THE GEOGRAPHIC DISTRIBUTION OF INTRINSIC NATURAL INCREASE IN THE UNITED STATES, AND AN EXAMINATION OF THE RELATION BETWEEN SEVERAL MEASURES OF NET REPRODUCTIVITY\*

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## PART I—NUMERICAL DATA

THE VITAL statistics of the United States for the year of the last census enable us to compute separately the "true" or "intrinsic" rates of natural increase for each of the States, except Maine, South Dakota and Texas.<sup>1</sup>

The results of these computations, as based on the white female population, are exhibited in Table 1, and, graphically, by graded shading, in the map Fig. 1. Ten States show high figures of over 10 per

### GEOGRAPHIC VARIATION IN THE TRUE RATE OF NATURAL INCREASE White Females in the United States, 1930

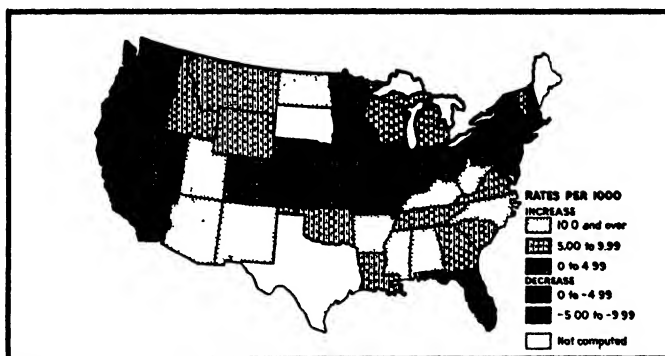


FIG. 1.

1,000 in the true rate of natural increase. Of these ten, six are Southern States. The four States with the highest rates of natural increase are Arizona with 12.69 per 1,000; Utah, 13.26; North Dakota, 13.29; and New Mexico, 18.28. It is to be noted that New Mexico and Arizona have a relatively large Mexican population (here included in the

\* Revision of a paper presented to the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 31, 1935.

<sup>1</sup> Separate life tables for each of the States, as required for this purpose, have been computed in the Statistical Bureau of the Metropolitan Life Insurance Company, and are published in a volume *Length of Life—A Study of the Life Table*, by Louis I. Dublin and Alfred J. Lotka, Ronald Press, 1936.



"white" statistics) with birth rates presumably above the average of the white population.

Twelve States still show favorable rates, namely, within the range of 5 to 10 per 1,000. Of these twelve, again six are Southern States. The last group of States showing a positive rate of natural increase, namely 0 to 5 per 1,000, includes eleven States. Practically all of these are concentrated in the northern half of the United States.

The remaining States for which computations are available show a deficiency, a negative rate of natural increase. Nine States have a true rate of natural decrease ranging from 0 to 5. All but two of these, Illinois and Missouri, are located on the coast line of the United States. Only one, Washington, is on the Pacific Coast and one, Florida, is in the South. The remaining five are in the industrialized northeastern area of the country. Lastly, the most unfavorable situation, with true rates of natural decrease between 5 and 10 per 1,000, is exhibited in the map by the black areas, including New York, Oregon, and California, which are also coast line States.

If we measure the degree of economic activity by the per cent of the white male population of age 10 and over engaged in manufacturing and mechanical industries, we see in Table 1, that, generally speaking, the States with the high percentages are also the States with true rates of natural decrease or with low true rates of natural increase. The degree of interdependence of the two factors is indicated by the coefficient of correlation, which figures out to  $-.65 \pm .09$ .<sup>2</sup> Such a figure represents a sizeable correlation, such as, for example, that between body weight and size (length) at birth. A closer correlation, namely,  $-.80 \pm .05$  is found when the true rate of natural increase is compared with the degree of urbanization, this latter measured by the proportion of the total population that is contained in municipalities of 2,500 or more inhabitants. It will be noted that the last twenty States on the list in Table 1 all have a degree of industrialization, and also of urbanization, below the average for the United States. Varying social composition (and perhaps other factors) may in part be responsible for the correlation observed.

#### RELATION BETWEEN THE REPLACEMENT INDEX AND THE TRUE RATE OF NATURAL INCREASE

The data collected in the investigation of the geographic distribution of our intrinsic natural increase furnish convenient material for examining the nature and relationship of three quantities that have been brought forward as measures of the effective fertility in a population.

<sup>2</sup> Throughout this article figures preceded by a plus and minus sign indicate standard errors.

TABLE I

TRUE RATE OF NATURAL INCREASE,\* NET REPRODUCTIVITY,\* AND REPLACEMENT INDEX, IN RELATION TO DEGREE OF INDUSTRIALIZATION AND URBANIZATION; UNITED STATES, INDIVIDUAL STATES,† 1929-1931

State	True rate of natural increase* per 1,000, p	Net reproductivity,* ratio of total births in two successive generations, R <sub>0</sub>	Replacement index based on children under one year old to women ages 20 to 45 (white) J	Per cent of population ages 10 and over engaged in manufacturing and mechanical industries White Males	Per cent of population contained in municipalities of 2,500 or more inhabitants‡ (Total persons)
(1)	(2)	(3)	(4)	(5)	(6)
Oregon	-6.90	.827	.834	23.5	51.3
California	-6.08	.849	.827	23.9	73.3
New York	-6.06	.842	.869	30.1	83.6
Washington	-4.44	.885	.897	25.6	56.6
Illinois	-4.43	.883	.911	28.1	73.9
New Jersey	-3.86	.896	.915	34.9	82.6
Massachusetts	-2.99	.917	.933	36.1	90.2
Florida	-2.94	.923	.977	19.8	51.7
Missouri	-2.46	.934	.962	20.3	51.2
Rhode Island	-2.45	.931	.953	41.4	92.4
Connecticut	-1.88	.948	.951	38.8	70.4
Maryland	-1.40	.962	.983	28.3	59.8
Ohio	0.02	1.000	1.015	32.1	67.8
Minnesota	1.10	1.033	1.054	17.4	49.0
New Hampshire	1.44	1.041	1.038	36.6	58.7
Indiana	1.52	1.043	1.070	28.0	55.5
Iowa	2.06	1.060	1.086	15.4	39.6
Delaware	2.10	1.060	1.046	29.4	51.7
Pennsylvania	2.23	1.065	1.108	30.7	67.8
Kansas	2.73	1.079	1.110	15.3	38.8
United States‡	2.82	1.079		25.5	56.2
Colorado	3.20	1.091	1.097	16.9	50.2
Nevada	3.45	1.096	1.087	18.1	37.8
Nebraska	3.66	1.110	1.147	13.1	35.3
Wisconsin	5.02	1.153	1.173	26.3	52.9
Michigan	5.22	1.155	1.198	35.2	68.2
Louisiana	6.44	1.195	1.306	17.6	39.7
Vermont	6.73	1.207	1.218	25.0	33.0
Montana	6.79	1.209	1.243	13.7	33.7
Virginia	7.22	1.227	1.302	19.2	32.4
Wyoming	7.46	1.229	1.269	15.1	31.1
Tennessee	8.30	1.260	1.335	16.1	34.3
South Carolina	8.42	1.267	1.374	22.1	21.3
Oklahoma	8.90	1.274	1.371	14.4	34.8
Georgia	9.13	1.291	1.375	16.9	30.8
Idaho	9.45	1.299	1.360	13.6	29.1
North Carolina	11.29	1.380	1.514	20.2	25.5
Kentucky	11.49	1.375	1.430	13.7	30.6
Alabama	11.52	1.379	1.550	16.3	28.1
Mississippi	11.58	1.380	1.476	10.9	16.9
West Virginia	11.68	1.383	1.511	18.8	28.4
Arkansas	12.52	1.411	1.464	10.7	20.6
Arizona	12.69	1.408	1.412	18.4	34.4
Utah	13.26	1.460	1.524	17.6	52.4
North Dakota	13.29	1.478	1.566	7.4	16.6
New Mexico	18.28	1.649	1.711	13.0	25.2

\* The true rate of natural increase and the net reproductivity are computed on the basis of the statistics for white females.

† Exclusive of Maine, South Dakota and Texas, for which the requisite data were not available.

‡ According to census of April 1, 1930.

§ Excludes Texas and South Dakota; includes District of Columbia.

I refer to the replacement index, on the one hand, and to the true or intrinsic rate of natural increase, or the corresponding net reproductiveity, that is, the ratio of total births in two successive generations, on the other.

*Replacement index.* The replacement index is formed by computing for the actual, and separately for the life table age distribution, the ratio of children under a given age, such as five years, to women in the childbearing ages, for example, ages 20 to 45.<sup>3</sup> Having computed these two ratios, the quotient is formed with the ratio in the actual population as numerator, and the ratio in the life table population as denominator.

**RELATION BETWEEN  
REPLACEMENT INDEX\* AND TRUE RATE OF NATURAL INCREASE  
FOR 45 OF THE UNITED STATES, WHITE FEMALES, 1930**

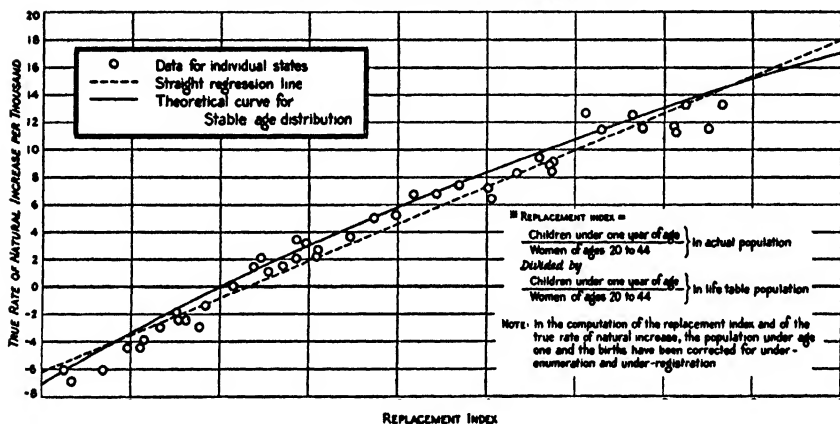


FIG. 2.

*True rate of natural increase.* The true rate of natural increase is that which would result from the prevailing age schedule of mortality and of fertility, if these conditions were allowed to operate for a sufficient length of time to establish their own characteristic stable age distribution. The method of computation of the true rate and the stable age distribution has been described in an earlier publication.<sup>4</sup>

*Comparison of replacement index and true rate of natural increase.* In the graph Fig. 2, there have been plotted as small circles the values of the true rate of natural increase, for the several States, as ordinates, against the corresponding values of the replacement index as abscissae. Correction has been made in each case for under-enumeration of the population in the first year of life, and for under-registration of births.

<sup>3</sup> Throughout this article age groups are defined in terms of "exact age"; that is, the lower limit corresponds to "age last birthday"; the upper to "age next birthday."

<sup>4</sup> *Journal of the American Statistical Association*, 1925, vol. 20, p. 329.

We can, following the routine procedure, compute a straight regression line and a coefficient of correlation connecting the two variates. We thus find for the coefficient of linear correlation the value of  $.985 \pm .005$  and for the regression equation of the true rate  $\rho$  of natural increase, against the replacement index  $J$

$$\rho = .02696 J - .02776. \quad (1)$$

But this is a rather crude procedure. Instead of accepting the relation between the two variates as an empirical fact, and fitting a straight line to the scatter of points by least squares, as shown by line of dashes in Fig. 2 we can seek to establish a rational connection between the variates, and, accordingly, to determine the curve representing this connection.

Now in the perfectly general case, with a purely arbitrary age distribution of the population, there would be no determinate relation at all between the replacement index on the one hand, and the true rate of natural increase on the other. In order to obtain a determinate relation we must assume some definite age distribution. On the assumption of the *stable* age distribution corresponding to the true rate of natural increase  $\rho$ , the replacement index has been computed for a number of different values of  $\rho$ . The resulting curve is shown in Fig. 2 by a solid line. As will be seen this curve fits the data very well.

This agreement of the computed curve with the scatter of points is at first sight surprising, for the actual age distribution differs quite markedly from the stable distribution, as is clearly evident from the chart Fig. 3. Also, the curve is drawn on the basis of the life table (1929-1931) for the population of the United States as a whole, whereas the points for the individual States have been computed on the basis of separate life tables, one for each State. The differences between these individual tables are in some cases considerable. Thus the expectation of life of white females at birth ranges between 52.22 years for New Mexico and 66.81 years for South Dakota. The reason for the good fit of the computed curve in spite of these differences is examined and explained in Part II.

*Relation between replacement index and net reproductivity.* In the regular process for computing the true rate of natural increase, there is obtained as an intermediate result the ratio  $R_0$  of births in two successive generations under constant and prescribed conditions of age-specific mortality and fertility. This ratio  $R_0$ , which may be termed the "net reproductivity," is defined by the equation,

$$R_0 = \int_0^{\infty} p(a)m(a)da \quad (2)$$

in which  $p(a)$  denotes the probability at birth of reaching age  $a$ , in the usual actuarial notation written as  $l_x/l_0$ ; the symbol  $m(a)$  denotes the age-specific fertility of women of age  $a$ , counting births of daughters only. The integral or summation may be extended over all ages of life or, which amounts to the same thing, only over the reproductive period, since outside of this period the factor  $m(a)$  is zero.

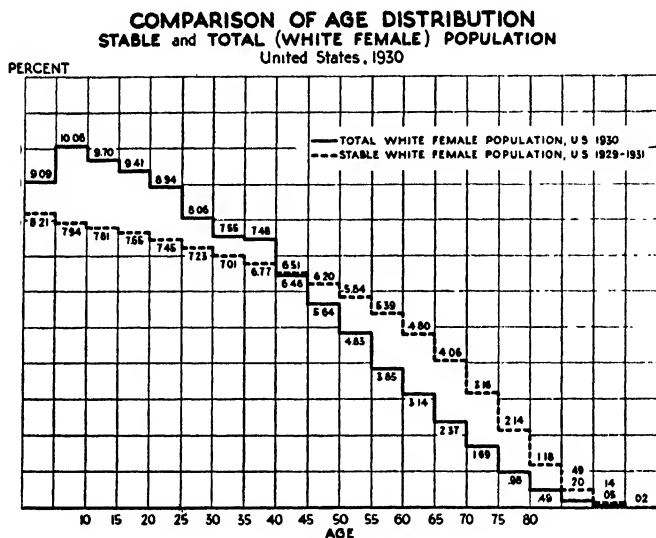


FIG. 3.

Figure 4, based on columns (3) and (4) of Table 1, shows the scatter of points representing the replacement index and the corresponding net reproductive<sup>5</sup> for each of the States of the Union, and a straight line (shown in dashes) fitted empirically by least squares to this scatter, as well as the rationally fitted curve (shown solid) computed on the assumption of the stable age distribution. The regression equation is

$$R_0 = .8654J + .1156. \quad (3)$$

## PART II. DEVELOPMENT AND DISCUSSION OF FORMULAE

*Relation between replacement index  $J$  and true rate  $\rho$  of natural increase in a population with stable age distribution.* The replacement index  $J$  is defined by

$$J = \frac{\int_0^a c(a) da}{\int_0^a c(a) da} \div \frac{b_0 \int_0^a p(a) da}{b_0 \int_0^a p(a) da} \quad (4)$$

<sup>5</sup> Values of the net reproductive for the several States of the Union have also been published by B. D. Karpinos in *Social Forces*, 1935, vol. 14, p. 218. His values, however, are not corrected for un-registered births.

where  $c(a)$  is the coefficient of age distribution, such that  $c(a)da$  gives the proportion of the actual population comprised within the age limits  $a$  and  $a+da$ , and  $p(a)$  is the probability at birth of surviving to age  $a$ ;  $p$  and  $q$  are respectively the lower and the upper limit of the junior age group which may be taken as comprising both sexes, and  $u$  and  $v$  are the corresponding lower and upper limits of the senior age

**RELATION BETWEEN  
REPLACEMENT INDEX \* AND NET REPRODUCTIVITY †  
FOR 45 OF THE UNITED STATES, WHITE FEMALES, 1930**

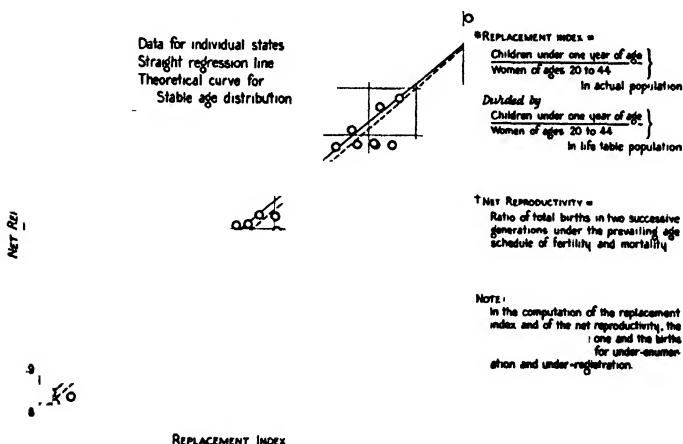


FIG. 4.

group of females, which, in particular, may be the group within the reproductive age period.<sup>6</sup> The symbol  $b_0$  denotes the birth rate per head in the life table population, in which the coefficient of age distribution is given by

$$c(a) = b_0 p(a). \quad (5)$$

In the case of a population with stable age distribution, and with true rate of natural increase  $\rho$  and birth rate per head  $b_\rho$ , the coefficient  $c(a)$  takes the form

$$c_\rho(a) = b_\rho e^{-\rho a} p(a) \quad (6)$$

so that the replacement index becomes

$$J = \frac{\int_p^q e^{-\rho a} p(a) da}{\int_u^v e^{-\rho a} p(a) da} \div \frac{\int_p^q p(a) da}{\int_u^v p(a) da}. \quad (7)$$

Let us put

$$y = y_\rho = \int_p^q e^{-\rho a} p(a) da \quad (8)$$

It will be shown in a later section how this condition can be generalised.

so that

$$y_0 = \int_p^q p(a) da \quad (9)$$

and similarly

$$z = z_p = \int_u^v e^{-pa} p(a) da \quad (10)$$

$$z_0 = \int_u^v p(a) da. \quad (11)$$

Then

$$J = (y/y_0) \div (z/z_0) \quad (12)$$

$$\log J = \log (y/y_0) - \log (z/z_0). \quad (13)$$

Furthermore,

$$\frac{dy}{d\rho} = - \int_p^q a e^{-\rho a} p(a) da \quad (14)$$

$$= - A \int_p^q e^{-\rho a} p(a) da \quad (15)$$

$$= - A y \quad (16)$$

$$\log_e (y/y_0) = - \int_0^\rho A d\rho \quad (17)$$

where

$$A = \int_p^q a e^{-\rho a} p(a) da / \int_p^q e^{-\rho a} p(a) da \quad (18)$$

$$= \alpha_1 + \beta_1 \rho + \dots \quad (19)$$

The coefficients  $\alpha_1, \beta_1$ , are obtained by expanding in the exponentials  $e^{-\rho a}$  under the integral signs, whereby series containing the moments of  $p(a)$  are obtained thus

$$A = \frac{M_1 - M_2 \rho + \dots}{M_0 - M_1 \rho + \dots} \quad (20)$$

where

$$M_n = \int_p^q a^n p(a) da \quad (21)$$

and where  $\alpha_1, \beta_1$  are respectively the mean and the square of the standard deviation taken with negative sign, of the function  $p(a)$  taken between the limits  $p$  and  $q$ , that is,

$$\alpha_1 = M_1/M_0 \quad (22)$$

$$\beta_1 = \alpha_1^2 - M_2/M_0. \quad (23)$$

Integrating (17) after introducing the expression (19) for  $A$ , we have

$$\log_e (y/y_0) = - (\alpha_1 \rho + \frac{1}{2} \beta_1 \rho^2 + \dots) \quad (24)$$

and similarly

$$\log_e (z/z_0) = - (\alpha_2 \rho + \frac{1}{2} \beta_2 \rho^2 + \dots) \quad (25)$$

the coefficients  $\alpha_2, \beta_2 \dots$  being exactly analogous to  $\alpha_1, \beta_1 \dots$ , except that the integrals (moments) are taken between the limits of age  $u$  and  $v$  (senior age group) instead of  $p$  and  $q$  (junior age group).

Finally, introducing (24), (25) in (13), we have

$$\log_e J = (\alpha_2 - \alpha_1) \rho + \frac{1}{2} (\beta_2 - \beta_1) \rho^2 + \dots \quad (26)$$

or, if  $\rho$  and  $(\beta_2 - \beta_1)$  are sufficiently small, and the terms of second and higher degree are negligible,

$$\log_e J = (\alpha_2 - \alpha_1) \rho. \quad (27)$$

The results obtained by these formulae agree very well with those computed directly from the corresponding stable age distribution, as will be seen from the data in tiers II, III and IV of Table 2. This table also exhibits a number of other features which will be referred to later, and which, for convenience in summarizing the results, have been collected together here in one table.

*Relation between replacement index and birth rate "per female in reproductive age group" in a population with stable age distribution.* If the lower age limit of the junior age group is zero, while its upper limit is brought down closer and closer to the lower age limit, then the mean age  $\alpha_1$  itself, of the group, approaches zero, and  $J$  approaches the value

$$\log_e J = \alpha_1 \rho. \quad (28)$$

This form of the relation has a certain special interest, for in this case the definition (4) of  $J$  becomes

$$J = \frac{c(0)}{\int_u^\infty c(a) da} \div \frac{b_0 p(0)}{b_0 \int_u^\infty p(a) da} = \frac{b_p}{\int_u^\infty c(a) da} \div \frac{b_0}{b_0 \int_u^\infty p(a) da} \quad (29)$$



On the other hand  $\alpha$  in the denominator, the mean of the net reproductivity curve of the women, is of the order of 28. The upshot of this is, that the exponent is of the order of unity.<sup>8</sup> In some of the examples presented herewith its value ranges between 1.04 and 1.06.

Inasmuch as this exponent is not very far from unity, we have as a first rough approximation that, with suitable choice of age limits for the junior and the senior age groups, the replacement index  $J$  is numerically equal to the net reproductivity  $R_0$  in a population with stable age distribution. It should be noted, however, that this is true only in a somewhat roughly approximate sense, except when  $R_0$  is unity, in which case the replacement index  $J$  is also exactly unity for a population with stable age distribution, as it should be, since the stable age distribution in this case reduces simply to the life table age distribution, and the numerator and denominator in the quotient defining  $J$  become equal.

It is of particular interest to note what would be the effect, upon the replacement index, of a change, for example, from one life table to another, or from one fertility curve to another. From the nature of things neither  $\alpha_2$  nor  $\alpha_1$  are very greatly affected by any such change. Even though the individual values in the survivor column in the life table in the range of ages from 20 to 45, for example, may be materially altered, this does not in general alter very greatly the mean age of this population group. A similar remark applies to the age group under 5 or under one and to the mean  $\alpha$  of the net fertility curve. Even though this curve be changed quite considerably in absolute amplitude, this does not as a rule involve much change in the mean age of this portion of the curve.

The result of all this is that the exponent  $(\alpha_2 - \alpha_1)/\alpha$  is not very greatly affected by changes in the life table or in the net fertility curve. This is clearly brought out by the data exhibited in Table 2. It also accounts for the fact that the theoretical curve in Figs. 2 and 4, based on a general life table for the United States as a whole, very adequately fits the scatter of points relating to 45 States whose life tables differ materially, the expectation of life of white females at birth ranging from 52.2 to 66.8 years.

*Effect of changing age limits of junior age group.* The selection of the limits of the junior age group is in considerable measure arbitrary, although the resulting value of the replacement index is not unaffected by the choice. For reasons of expediency, the age group 0 to 5 will usually be employed. It is, however, interesting to ascertain within

<sup>8</sup> It should be noted that this fact arises from the choice of the age limits 20 to 45 in forming the replacement index. Had the limits 15 to 45 or 20 to 50 been used, the exponent would not be so nearly equal to unity.

what limits the values of  $J$  will vary if the limits of the junior age group are taken from 0 to 5, or to 4, 3, 2 or 1, or if the births are used instead of the junior age group. The variation in  $J$  produced by thus changing the age limits of the junior age group in a population with stable age distribution is exhibited in Table 3 on the basis of the life

TABLE 3

VARIATION IN REPLACEMENT INDEX WITH CHANGE OF UPPER AGE LIMIT OF JUNIOR AGE GROUP IN A POPULATION WITH STABLE AGE DISTRIBUTION, BASED ON LIFE TABLE FOR WHITE FEMALES, UNITED STATES, 1929-1931

Junior age group*	True Rate of Natural Increase per Head					
	.03640	.02800	.01736	.00265	-.02170	-.04516
	Replacement Index					
Age 0†	3.130	2.420	1.738	1.089	.490	.221
Under 1	3.082	2.373	1.717	1.087	.498	.228
Under 2	3.004	2.344	1.704	1.086	.503	.233
Under 3	2.985	2.315	1.690	1.084	.508	.237
Under 4	2.905	2.285	1.677	1.083	.513	.243
Under 5	2.856	2.255	1.663	1.082	.518	.248
30-35*	2.752			1.079		

\* The senior age group in each case is 20-45 years, with the single exception of the case where the junior age group is 30-35 years, the senior age group here being taken as 50-75 years. The values shown in this table have been computed directly from the corresponding stable age distributions.

† Annual births (see text pp. 281-282).

table for the white female population of the United States in 1929-1931, and for a selected number of values of the true rate of natural increase. It will be seen that the variation, though not very marked, is not altogether negligible. Thus  $J$ , the replacement index, is not a unique measure of net fertility, and in this respect is inferior to the true rate of natural increase.

TABLE 4

Age groups	Mean Age			Ratio* $\frac{\alpha_2 - \alpha_1}{\alpha}$
	Junior age group $\alpha_1$	Senior age group $\alpha_2$	Difference $\alpha_2 - \alpha_1$	
Under 5 combined with 20 to 45	2.483	32.285	29.802	1.0630
30 to 35 combined with 50 to 75	32.491	61.125	28.634	1.0213

\*  $\alpha$  = mean age of net fertility curve.

*Effect of simultaneous parallel shift of junior and senior age groups.* Evidently the general character of the relations (27), (33) will be little affected by any change which leaves the exponent  $(\alpha_2 - \alpha_1)/\alpha$  approximately unaltered. Thus, if instead of the age groups "under 5" combined with "20 to 45," we base the computation on the age groups "30 to 35" combined with "50 to 75," we find the values shown in Table 4 for  $\alpha_2$  and  $\alpha_1$ , their difference, and the exponent  $(\alpha_2 - \alpha_1)/\alpha$ .

This suggests that from the same population we should be able to obtain a series of values of the replacement index  $J$ , by using successively higher pairs of equidistant age groups.

It should be noted that the replacement indexes derived from such successively higher pairs of age groups represent successively earlier generations. This gives us an opportunity in the case of an actual population, to obtain evidence of the time trend in the replacement index.

The computation has been carried out for a succession of pairs of age groups in the actual population of the United States at the time of the last census (1930). The results are shown in Table 5. The series of figures in column 3 very clearly exhibits the shift in the replacement index towards higher values, as we trace it backwards in time, indicating the higher fertility of early calendar years. The figures, however, for more remote years, can be taken only as a very rough measure.

TABLE 5  
TREND OF REPLACEMENT INDEX FOR SUCCESSIVELY HIGHER AGE GROUPS,  
WHITE FEMALES IN THE U. S., IN 1930  
COMPUTED ON THE BASIS OF A LIFE TABLE FOR WHITE FEMALES,  
U. S., 1929-1931

Junior age group (1)	Senior age group (2)	Replacement index $J$ (3)	Average year of birth of junior group (4)
0-5	20-45	1.088	1928
5-10	25-50	1.309	1923
10-15	30-55	1.359	1918
15-20	35-60	1.444	1913
20-25	40-65	1.558	1908
25-30	45-70	1.595	1903
30-35	50-75	1.700	1898
35-40	55-80	1.933	1893
40-45	60-85	1.886	1888
45-50	65-90	1.878	1883

It should also be noted that there is a fundamental difference between the replacement index computed on the basis of a junior age group concentrated near age zero, and a replacement index computed on more advanced age groups. In the former case the junior age group is affected but little by immigration, since relatively few small children enter the country. In the latter case the junior age group will be more and more influenced by immigration as the age limits selected for it advance. This fact must be taken into account in viewing the figures in the table. It will tend to raise the value of the replacement index computed for more advanced ages, because then the junior age group contains persons who are not children of the senior age group.

The senior age group will of course always be affected by immigration if the computation is based on the total population. This is as it should be if the replacement index for the total population is desired.

A separate index can, if desired, be computed for the native-born population alone.

*Application to population with actual age distribution other than stable.* Formulae have so far been developed only for a population with stable age distribution corresponding to the true rate of natural increase. From the example presented by the actual figures for the several States of the Union, as exhibited graphically in Figs. 1, 2, and 4, it is clear that certain of these formulae still apply even when the age distribution differs very materially from the stable, as shown in Fig. 3. This requires explanation, to which we now proceed.

Anticipating somewhat the argument and results that will be developed, it may briefly be stated that the applicability of the formulae to any population propagated essentially by the excess of births over deaths (i.e. in the absence of any considerable immigration of infants), arises from the fact that the zero ordinate (representing the births) in the age distribution diagram is always directly related to the area comprised within the reproductive ages, regardless of what may happen to the ordinates in other age regions of the diagram.

We now proceed to a more exact consideration of these relations.

*Relation between total annual births in two calendar years one mean generation apart.* Let  $B(t)$  be the total annual births at time  $t$ , and let  $m(a)$  denote the maternity frequency (gross fertility) of women of age  $a$  counting daughters only; let  $p(a)$  be the probability for a newborn female to reach age  $a$ . Then, since the annual births  $B(t)$  at time  $t$  arise from mothers born  $a$  years ago at time  $(t-a)$ , we have

$$\frac{\int_0^{\infty} B(t-a)p(a)m(a)da}{\int_0^{\infty} p(a)m(a)da} = \frac{B(t)}{\int_0^{\infty} p(a)m(a)da} \quad (34)$$

$$B(t-\bar{a}) = B(t)/R_0 \quad (35)$$

where  $\bar{a}$  is the average age defined by the left-hand member of equation (34). If  $B(t-a)$  is nearly linear as a function of  $a$ , within the limits of the reproductive age period, then the average  $\bar{a}$  defined above is nearly the same as the average age<sup>9</sup>  $\alpha$  defined by

$$\alpha \int_0^{\infty} p(a)m(a)da = \int_0^{\infty} ap(a)m(a)da \quad (36)$$

<sup>9</sup> This will be seen to result from the following demonstration that the average of a linear function of  $x$  is equal to the same function of the corresponding average of  $x$ .

$$\text{If} \quad \phi(x) = a + bx \quad (38a)$$

$$\bar{\phi}(x) = \frac{\int \phi(x)f(x)dx}{\int f(x)dx} = a + b \frac{\int xf(x)dx}{\int f(x)dx} = a + b\bar{x} \quad (38b)$$

that is,  $\alpha$  is to this approximation simply the average age of the female net reproductivity curve, which has previously been denoted by  $\alpha$ , and we can write

$$B(t)/B(t - \alpha) = R_0 \quad (37)$$

$$= e^{\rho \alpha} \text{ approximately.} \quad (38)$$

If  $\alpha_2 - \alpha_1$  does not differ greatly from  $\alpha$ , it will still be nearly true that

$$B(t)/B(t - [\alpha_2 - \alpha_1]) = e^{\rho(\alpha_2 - \alpha_1)}. \quad (39)$$

Put

$$t = \tau - \alpha_1. \quad (40)$$

Then

$$B(\tau - \alpha_1)/B(\tau - \alpha_2) = e^{\rho(\alpha_2 - \alpha_1)} \quad (41)$$

and since this is true for all values of  $\tau$ , we can simply write

$$B(t - \alpha_1)/B(t - \alpha_2) = e^{\rho(\alpha_2 - \alpha_1)}. \quad (42)$$

Now, for *any* population,  $J$  has been defined as

$$J = \frac{\int_p^a c(a) da}{\int_u^a c(a) da} \div \frac{\int_p^a p(a) da}{\int_u^a p(a) da} \quad (43)$$

and since the  $N(t)c(a)da$  females of ages  $a$  to  $a+da$  at time  $t$  are the survivors of the  $B(t-a)da$  females born at time  $t-a$  within a time interval  $da$

$$N(t)c(a)da = B(t-a)p(a)da. \quad (44)$$

Hence

$$J = \frac{\int_p^a B(t-a)p(a)da}{\int_u^a B(t-a)p(a)da} \div \frac{\int_p^a p(a)da}{\int_u^a p(a)da} \quad (45)$$

$$= \frac{\int_p^a B(t-a)p(a)da}{\int_p^a p(a)da} \div \frac{\int_u^a B(t-a)p(a)da}{\int_u^a p(a)da} \quad (46)$$

$$= B(t - \alpha_1)/B(t - \alpha_2) \quad (47)$$

$$\log_e J = (\alpha_2 - \alpha_1)\rho \text{ by (42).} \quad (48)$$

Lastly, since

$$\log_e R_0 = \rho\alpha \quad (\text{approximately}) \quad (49)$$

we have, in view of (48),

$$\log_e J = (\log_e R_0)(\alpha_2 - \alpha_1)/\alpha \quad (50)$$

$$J = R_0^{(\alpha_2 - \alpha_1)/\alpha}. \quad (51)$$

These results explain why the relations (48) and (50), developed primarily for a population in stable age distribution, have been found to apply to an actual population with age distribution differing markedly from the stable. Also, since in the last step in the development above, all explicit reference to the life table cancels out, we have here the explanation of the fact that the curve computed on the basis of the life table for the United States as a whole adequately fits the scatter of points relating to 45 individual States having separate mortality characteristics.

Furthermore, the development leading up to equations (48) and (50) involves no assumptions regarding the age limits  $p, q$  of the junior age group, and  $u, v$  of the senior age group, except that the difference of their means should not be widely different from  $\alpha$ , the mean age of the (female) net reproductivity curve. It follows that the conclusions reached, that is equations (48) and (50), continue to hold if the junior and senior age groups are shifted simultaneously so as to keep them the same distance apart. However, the particular value of  $J$  obtained relates in each case approximately to the mean calendar year of birth of the junior age group.

While the age limits  $p, q; u, v$ , are to some extent arbitrary, it is clear that the entire argument presupposes them to be so chosen that the persons comprised within the junior age group are *essentially* the children of those in the senior age group. This implies that the junior age group must not be unduly wide. In practice a width of five years has commonly been used, while the width of the senior age group has naturally been made to cover essentially the length of the (female) reproductive period.

Incidentally, it should be remarked that if there is any considerable immigration or emigration, the relation between the junior and senior age groups can in general<sup>10</sup> no longer be expressed exclusively in terms of the annual births within the United States; that is, equation (44) no longer holds. For this reason, in a population which in the past has had considerable immigration, the values of the replacement index  $J$

<sup>10</sup> That is, when the junior age group is taken, not near age zero, but at some higher age.

computed from advancing pairs of age groups will tend to be unreliable, as has already been indicated (p. 286).

*A property of the net reproductivity.* The net reproductivity has been defined and computed as the ratio of the total births in two successive generations under the régime of given constant age schedules of fertility and mortality.

We have passed by without special mention an interesting property of the net reproductivity, expressed by equation (37) namely that this net reproductivity  $R_0$  is also approximately the ratio of the total births, in any "closed"<sup>11</sup> population, at two epochs of time  $t$  and  $(t-\alpha)$  taken  $\alpha$  years apart, where  $\alpha$  is the mean age of the (female) net reproductivity curve. In this case the  $R_0$  so computed is not necessarily a constant, but relates to the fertility and mortality prevailing at the time  $t$ .

We have already made use of this property in the development of equation (48). We proceed now to another application.

*Application to actual population of the United States.* By way of a numerical example the relation

$$R_0 = B(t)/B(t - \alpha) \quad (37)$$

was applied to the population of the United States in 1928, for which a computation of  $R_0$  was on record.<sup>12</sup> The total number of births in the Birth Registration Area in 1928 was 2,233,149; in 1929 it was 2,169,920. The corresponding fractions of the total population comprised within that area were 94.3 and 94.7 per cent respectively. Making due allowance for this, we find, for the mean total annual births 1928/1929 the figure of 2,330,000.

To apply our formula we must also have a figure for the total annual births 28.5 years prior to 1928/1929 that is, for the year 1900. Now, direct statistics of births in the United States are not available prior to 1915. But we have an estimate<sup>13</sup> of the birth rate in 1900, namely 29.48 per 1,000. The total population at that time was 75,994,575, from which we infer that the total births were 2,240,000. We thus have

$$B(t)/B(t - \alpha) = 2,330,000/2,240,000 \quad (52)$$

$$= 1.040 = R_0. \quad (53)$$

Actual determination from the fertility and mortality of the white females in the Birth Registration States of 1920 in 1928 gave  $R_0 = 1.049$ .<sup>14</sup>

<sup>11</sup> That is, a population growing solely by natural increase, in the exclusion of immigration or emigration.

<sup>12</sup> L. I. Dublin and A. J. Lotka, *Metron*, vol. 8, 1930, p. 113.

<sup>13</sup> L. I. Dublin and A. J. Lotka, *Journal of American Statistical Association*, 1925, vol. 20, p. 318.

<sup>14</sup> Id. *Metron*, 1930, vol. 8, p. 107.

A similar computation carried out for the United States in the year 1933 gives for  $R_0$  the value .883 computed from the total births in 1933 and in 1905. The value of  $R_0$  obtained directly from the birth statistics and estimated white female population of 1933 is .866.

*Application to a population with logistic growth.* While certain of the formulae developed in the preceding sections are of general application, it is interesting to observe how they work out when applied to the special case of a population growing according to the logistic curve.

It will be recalled that certain populations have followed this curve fairly closely over considerable periods of time. In particular, the population of the United States, until the date of the last census, was represented in very good approximation by the curve defined by the equation

$$N(t) = \frac{N_{\infty}}{1 + e^{-rt'}} = \frac{197,493,000}{1 + e^{-.0314t'}} \quad (54)$$

where  $t'$  is measured from 1914.6. At the time of the last census, the observed population differed by only three-tenths of one per cent from the value calculated according to that formula. Since then the rate of increase has probably been materially less than that demanded by the curve, and the extension of the curve into future years must be regarded as a mathematical construction rather than as in any sense a forecast. Nevertheless, in view of the close fit of the curve to the past growth of the population, and in view of the general interest of the curve, the case of a population growing according to this law makes an interesting example in terms of which to examine the applicability of formula (37) to the case of a population with age distribution other than stable.

On a previous occasion<sup>15</sup> the writer has developed the curve of annual births  $B(t)$  at time  $t$  corresponding to the population  $N(t)$  growing according to the logistic curve, on the basis of the constants characteristic of the population of the United States. The series of values thus obtained, while patterned essentially on the type of the American population, is to this extent hypothetical, that computations were conducted on the basis of a fixed life table (that of 1919-1920) and of a "closed" population, that is, one in which growth takes place entirely by an excess of births over deaths. Inasmuch as the purpose of the example here given is to illustrate the applicability of formulae (37) and (56) to a population with age distribution other than the "stable," the fact that the numerical data are hypothetical, to the extent indi-

<sup>15</sup> For details the reader must be referred to the original publication, A. J. Lotka, "Structure of a Growing Population," *Human Biology*, 1931, vol. 3, p. 459.



cated, is immaterial, and for the same reason we may, merely by way of example, base computations on that part of the curve which is entirely hypothetical and extends beyond the date of the last census. With this in mind, the formula (37) has been applied to the series of values of  $B(t)$  computed on the basis indicated.<sup>16</sup> The results are shown

TABLE 6  
COMPARISON OF RATIO OF ANNUAL BIRTHS AT TWO CALENDAR PERIODS ONE MEAN GENERATION APART, WITH CORRESPONDING RATIO OF TOTAL BIRTHS IN TWO SUCCESSIVE GENERATIONS; ALSO, CORRESPONDING VALUES OF THE TRUE RATE OF NATURAL INCREASE; COMPUTED FOR A LOGISTIC POPULATION WITH CHARACTERISTIC CONSTANTS OF THE UNITED STATES\*

Year $t$	Annual births		Crude rate of natural increase, $r \ddagger$	Mean length of generation, $T \ddagger$	Annual births	
	$B(t)$	$B(t-a) \ddagger$			$B(t-T)$	
1	2	3	4	5	6	
1800	218697	91897	.0306	27.78	93870	
1825	454475	197055	.0296	27.80	201064	
1850	890975	411709	.0277	27.84	419184	
1875	1567415	815688	.0243	27.92	827261	
1900	2330669	1462024	.0191	28.04	1474927	
1920	2797246	2082021	.0143	28.15	2091788	
1925	2882723	2231455	.0131	28.17	2240209	
1950	3164261	2824622	.0077	28.30	2827606	
1975	3303823	3136262	.0040	28.38	3137024	
2000	3373610	3289582	.0020	28.43	3289754	

Year $t$	Net reproductiveity, $R_0(t)$ = ratio of total births in two successive generations			True rate of natural increase, $\rho(t)$ , computed ¶ from $\alpha$ , $\beta$ , and $R_0(t)$ , using values of $R_0(t)$ as given in		
	$B(t)R_0' \S$	$B(t)$	$B(t)$	col. 7 ¶	col. 8	col. 9
	$\Sigma m'(a)c(a, t)$	$B(t-a)$	$B(t-T)$			
1	7	8	9	10	11	12
1800	2.329	2.380	2.330	.0304	.0312	.0304
1825	2.260	2.306	2.260	.0293	.0301	.0293
1850	2.127	2.164	2.125	.0271	.0277	.0271
1875	1.899	1.922	1.895	.0229	.0234	.0229
1900	1.588	1.594	1.580	.0165	.0166	.0163
1920	1.346	1.344	1.337	.0105	.0105	.0103
1925	1.296	1.292	1.287	.0092	.0091	.0089
1950	1.125	1.120	1.119	.0042	.0040	.0040
1975	1.056	1.053	1.053	.0019	.0018	.0018
2000	1.027	1.026	1.025	.0009	.0009	.0009

\* Equation (54).

†  $\alpha = 28.47$  years;  $\beta = -45.39$ .

‡  $T = \alpha + \frac{1}{\beta} \ln r$  (very nearly).

§ A. J. Lotka, "Structure of a Growing Population," *Human Biology*, 1931, vol. 3, p. 479;  $R_0'$  and  $m'(a)$  are computed from observed mortality and fertility statistics in the United States, 1920, as explained *loc. cit.*, pp. 475-476.

$$\ddagger \rho(t) = \frac{1}{\beta} \left\{ -\alpha + \sqrt{\alpha^2 + 2\beta \log_e R_0(t)} \right\}.$$

in column 8 of Table 6. For comparison the values of  $R_0(t)$  and  $\rho(t)$  computed directly from the age distribution in the logistic population at selected calendar periods are shown in columns (7) and (10) of the same table.

<sup>16</sup> *Loc. cit.* 459, 466.

It will be seen that the agreement is excellent for 1900 and later dates.

For the earlier dates a formula a little more exact than (37) can be given. It will be recalled that in the early stages of the logistic curve, growth is approximately according to the law of compound interest (geometric increase). In that case the mean length of the generation, which in preceding sections has been expressed (approximately) by  $\alpha$ , can be expressed with greater accuracy by

$$T = \alpha + \frac{1}{2}\beta r_t \quad (55)$$

where  $r_t$  is the rate of natural increase at time  $t$ . This suggests replacing the formula (37) by

$$\frac{B(t)}{B(t - T)} = \frac{B(t)}{B(t - \alpha - \frac{1}{2}\beta r_t)} R_0(t). \quad (56)$$

The results of the computation carried out on this basis are shown in columns (9) and (12) of Table 6. It will be seen that for calendar years up to and including 1875 the amended formula (56) gives excellent agreement with the values in columns (7) and (10) computed directly from the age distribution. For later calendar years unimportant divergences of one or two units in the last retained decimal appear.

#### SUMMARY

Part I presents numerical data of the computed values of the true rate of natural increase  $\rho$ , the net reproductivity  $R_0$ , and the replacement index  $J$ , for each of 45 States of the Union, and incidentally exhibits the relation between the net reproductivity and the degree of industrialization and urbanization of the several States. In this first part are also exhibited empirically, on the basis of the computed values, and illustrated by means of graphs, the relation between the replacement index and the true rate of natural increase, and also the relation between the replacement index and the net reproductivity.

Part II exhibits the rational development on a theoretical basis, of the relations between the replacement index, the net reproductivity, and the true rate of natural increase. The formulae are developed primarily on the basis of a population in stable age distribution. The numerical values of the various constants involved, and the effect of variations of these constants is discussed: Effect of changing age limits

of the junior age group; effect of simultaneous shift of junior and senior age groups.

Empirically, it has been found that the formulae developed on the basis of a stable age distribution were still applicable in close approximation to certain populations differing markedly from the stable age distribution. The reason for this continued applicability is investigated.

As a by-product of the investigation, it is found that the ratio  $R_0$  between the total births in two successive generations, as computed from the fertility and mortality prevailing at a given instant, is also very nearly the ratio of the annual births in the same population at two calendar periods one mean generation apart, even though the fertility and mortality may in the meantime have undergone considerable changes. Examples are shown of the application of this to an actual population (United States, 1928 and 1900 and also 1933 and 1905) and to a theoretical population growing according to the logistic curve.

# THE A.A.A., THE COTTON GROWERS, AND THE AGRICULTURAL PROBLEM\*

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COTTON growing plays a very important part in our complicated economic and social organization in the United States. Correct understanding of the effects of the A.A.A. and the present administration of it on the welfare of the cotton industry and through it on our whole economic and social life can scarcely be attained without understanding the origin and extent of the influence of the cotton industry in shaping the nature and development of American agriculture and the relation of agriculture to modern trade and industry.

To bring these interdependent relationships of the cotton industry into proper perspective I propose in this paper to suggest a new approach to the cotton problem in particular and the whole agricultural problem in general. Accordingly, the first part of my discussion will be a brief analysis of the purpose and program of the A.A.A. and the effects of that program on cotton farmers and the cotton growing South down to the present time. The second part will discuss cotton as the key to agricultural recovery.

## AGRICULTURAL PROBLEMS AS STATED BY THE A.A.A.

According to Title I of the A.A.A., the fundamental problem of agriculture as the framers of the Act conceived it was price disparity between agricultural commodities and other commodities. In the opinion of the framers of the A.A.A. the trouble lay in the relatively low prices of agricultural products due to over-production.

## REMEDY PROPOSED

Briefly stated, the objective for cotton was price parity with an arbitrarily selected base period of July 1909 to August 1914. The program adopted to attain price parity for cotton was to levy a heavy processing tax on raw cotton consumption in the United States, to get money, to cut down acreage, to reduce supply, to raise price. Stripped of all its frills, this program is essentially an attempt to

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I have chosen to discuss in this paper only the cotton growers and the agricultural problem. My colleague, Dr. F. A. Buechel, is making a study of the livestock industry similar to the one I am making for cotton.

bring about a redistribution of wealth by forcibly slowing down production, or the destruction of the processes of real wealth production in one branch of our economic organism, agriculture, to exact a monopoly advantage from others.

Undoubtedly, the belief in the feasibility of this idea was based on the discovery from an analysis of *Agricultural Yearbook* figures that random short crops of cotton in the United States have generally brought more dollars to the cotton growers than large crops coupled with the assumption that planned acreage reduction would bring short crops, and the further assumption that planned short crops would have the same results on prices as random short crops.

#### RESULTS OF THE COTTON RESTRICTION PROGRAM

To understand the far-reaching effects of the cotton restriction program it is necessary to know that the major portion of the economic life of the South revolves around cotton. Cotton is not only the main source of income for 2,000,000 cotton growers, almost a third of all the farmers in the United States, but either directly or indirectly the major activities of the cities and towns in the region revolve around it. The cotton business, then, is a great interdependent complex of activities in which each group engaged in it is greatly benefited by the efficient work of the others and is thus more or less obligated to them. Thus, the great mass of cotton choppers and pickers, ginners, cotton seed crushers, and cotton merchants in reality represent an enormous amount of more or less stand-by equipment to serve the cotton growers.

The cotton restriction program fails to recognize these interdependent relations. As a result, hundreds of thousands of people in the South have been forced on to relief rolls. Regardless of what visionary reformers may say, employment is still a function of production, and production in such a predominantly important enterprise as cotton production cannot be cut one-third without creating a grave unemployment problem.

Those with even a school boy understanding of the cotton industry are not surprised that long relief rolls persist in the South, when their attention is called to the fact that during the past three years cotton production has been cut approximately 13,400,000 bales. The total amount of effective employment destroyed by this ill-conceived policy, that the best way to get more is to do less, is staggering in the extreme. It has meant the loss of about \$83,000,000 in cotton picking, \$64,000,000 in cotton ginning, \$47,000,000 in transportation, about \$58,000,000 in compressing, warehousing, merchandising, and in other

marketing costs made up mostly of labor. The 13,400,000 bales of cotton the Government kept out of production would have resulted in the production of about 5,400,000 tons of cotton seed which would have had a manufacturing value of about \$29,000,000. These items do not include preparation of land, planting, cultivation and hoeing, very important items in employment, and yet the figures I have given total \$281,000,000. The predominant amount of this money would have gone to unskilled, unorganized laborers and tenant farmers, the very people who are now being forced to ask for a dole to keep from starving.

#### COTTON PRODUCTION CONTROL TO RAISE PRICE

Since the A.A.A. contends that price parity is the one big objective in agriculture and that the primary means of attaining that parity is restriction of production to raise price, in their opinion the measure of success must be the extent to which the price of cotton has been raised.

The season 1934-35 undoubtedly provided the most ideal opportunity for testing the value of the scheme. One of the most severe droughts in our history combined with Government-enforced acreage reduction reduced the United States crop to 9,469,000 gin bales, which was the lowest production since 1899 with the exception of the disastrous crop failure of 1921-22. In addition to the unprecedented short crop, the Government took out of the market about 4,500,000 bales of the crop with a 12-cent loan. Undoubtedly that, combined with private speculation, inaugurated one of the strongest holding movements in history. The combination of very low production, removal of one-third of this small crop from the market, and private speculation should have raised the price of cotton if such a program could do it. Did it do it then, or has it done it since? Let us see. If it has not, the futility of the program is obvious, and the injury to the farmers enormous.

#### COTTON PRICES IN GOLD

Cotton is a world commodity. Its price is a world price made in grains of gold. This is true because: (1) gold is a universal standard for measuring value; (2) cotton is a relatively non-perishable commodity in universal demand; and (3) American cotton has a merchandising force behind it offering it in all world markets. Since gold can be converted into any currency at that currency's gold value, changes in the gold price of cotton are caused by changes in supply and/or demand for cotton. It follows then that if there is an advance in the currency price in one country without a corresponding advance in the currency prices of other countries or the gold value of cotton, it is conclusive

proof that in the first instance the advance was due to a decline in the gold value of the currency. Let me illustrate: American cotton merchants with offices and close trading relations in all world cotton markets price cotton in the currency of each country in terms of its convertibility through exchange into grains of gold. Their objective is to sell their cotton in the market that will yield them the greatest number of grains of gold net. It is obvious, of course, that the sale yielding the greatest number of grains of gold net will also yield the greatest number of dollars or units of any other free currency. The amazing exactness with which this pricing is done is shown by the fact that trades are turned in the market on the basis of .0013 of a grain of gold per pound, equal to 1/100 of a cent at the present gold value of the dollar. This amounts to only one nickel a bale. How can it be done? It can be done because merchants deal in units of 100 bales in exporting cotton and selling to mills. Evidently these small trading margins show how entirely impossible it is for gold prices of cotton to get far out of line from one country to another and stay that way for long.

If the above statement is correct, then the price of cotton in United States dollars should have gone up approximately 69.5 per cent without any change in the world's gold price. On the other hand, if the price in dollars did go up about 69.5 per cent while the gold price remained the same, it is proof positive that it was the decline in the gold value of the dollar which put the price up in dollars, and the restriction program as a price-raising device has been a failure. Let us examine the facts.

The average price of American cotton in Havre, France, April, 1933, was 1.86 grains of gold per pound. In April, 1935, the average price was 1.95 grains of gold, an advance in the two years of .09 of a grain of gold. This is the equivalent of approximately 39 points, or .39 of a cent a pound. The average price of New Orleans spot cotton in April, 1933, was 6.88 cents. Taking into account the .09 of a grain of gold advance in the price in Havre, the average price of New Orleans spot cotton in April, 1935, should have been 12.05 cents in terms of the 13.7137 grains of gold or devalued dollar. It was actually only 11.80 cents. December 12, 1935, the price of American cotton in Havre was quoted at 1.86 grains of gold per pound. It is important to note that this was exactly the price in April, 1933. The price of New Orleans spot cotton, December 12, 1935, was 11.65 cents, and this is equal to 6.87 cents in terms of our old 23.22 grain dollar. On December 14, 1935, while this is being written, the price has declined to 11.47 cents, or only 6.77 cents in terms of the old dollar. These facts show beyond any shadow of a doubt that there has been no advance in the gold price of cotton and that the advance in the dollar price in the United States has been due

entirely to the reduction in the gold value of the dollar from 23.22 grains of gold to 13.7137 grains, or to 59.06 per cent of its former value. These facts also prove that the A. A. A. and the Bankhead Act as a means of raising the price of cotton have been utter failures.

Figure 1 shows the movement of the gold price of American cotton in Havre from 1931 to date, the New Orleans spot price in cents per

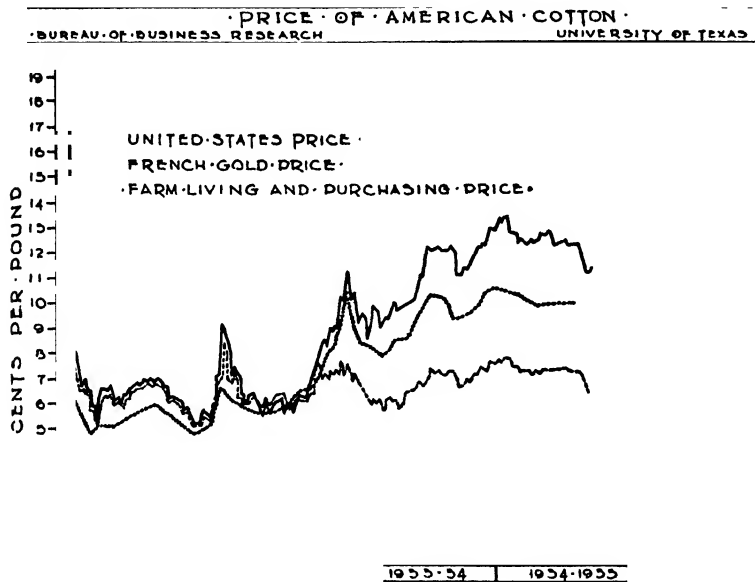


FIG. 1.

pound, and the farm living and purchasing price of cotton. This presents a more detailed analysis of the fact that gold prices of cotton have not advanced, that now, December 14, 1935, the price is actually lower than it was in April, 1933, and that the advance in the dollar price has been due to the cheapened dollar.

Figure 2 shows graphically the relation of the fall in the gold value of the dollar during the devaluation process and the dollar rise in the price of cotton.

The facts presented so far show that the cotton restriction program has prevented hundreds of millions of dollars in employment, has put millions of people on relief, and has been an utter failure as a scheme for raising cotton prices.

#### PARITY PRICE FOR COTTON

Since the passage of the A.A.A. much has been said about parity price. As defined in the Act and interpreted by the Administration,



parity price of cotton means a price with a buying power per pound of cotton equal to the average buying power of a pound from July 1909–August 1914. This parity price is worked out each month and published by the U. S. Department of Agriculture in the *Agricultural Situation*. For September the parity price is listed as 15.90 cents. Does that mean that if cotton growers were now getting 15.90 cents per pound they would have the same buying power as they had in 1909–14? Absolutely not. The fact is, if the method of raising prices is through reduction of

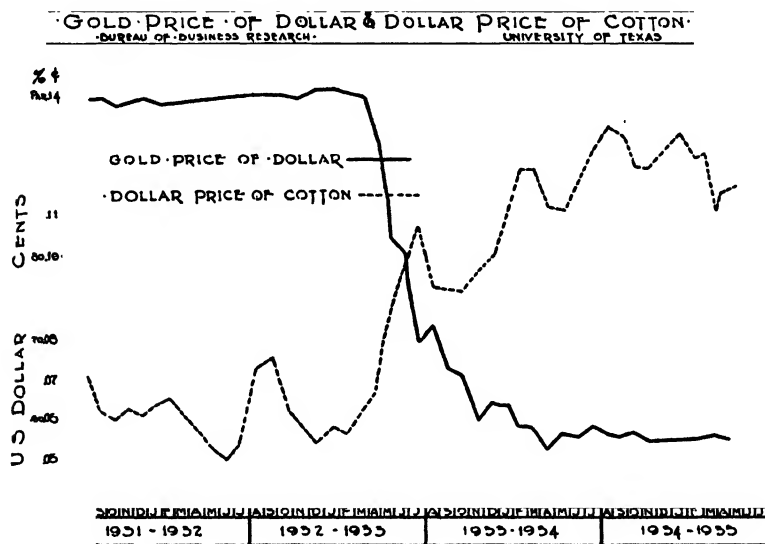


Fig. 2.

production, as the A.A.A. has attempted, the total income of the cotton grower may be lowered at the same time the price per pound is raised. Since the gold price of cotton has not been raised (reasons for which will be explained later) it takes no stretch of the imagination to see what would have happened in the South when cotton production was cut a third, as it has been, if we had not had the devaluation of the dollar at the same time which raised prices of cotton faster than most things the cotton growers buy. Indeed, the cotton growers would now be having the hardest time in their history; and, of course, thousands of the tenants and small farmers have had no profit from devaluation because they have been converted from producers to laborers. Their only alternative has been the relief roll. As prices of other things become adjusted to the cheap dollar, cotton will rapidly and surely lose the relative advantage in buying power it gained by devaluation. At that time cotton growers will pay and pay dearly for markets lost be-

cause of the A.A.A. and the Bankhead Act. Figure 1 shows that the "living and production" price of cotton is already rapidly leaving the dollar price and approaching the gold price. Make no mistake, that means that hard times for cotton growers.

Figure 3 shows the relationships between the New Orleans spot price, price actually received by farmers, the U. S. Department of Agriculture parity price, and, finally, what I have designated as parity income price.

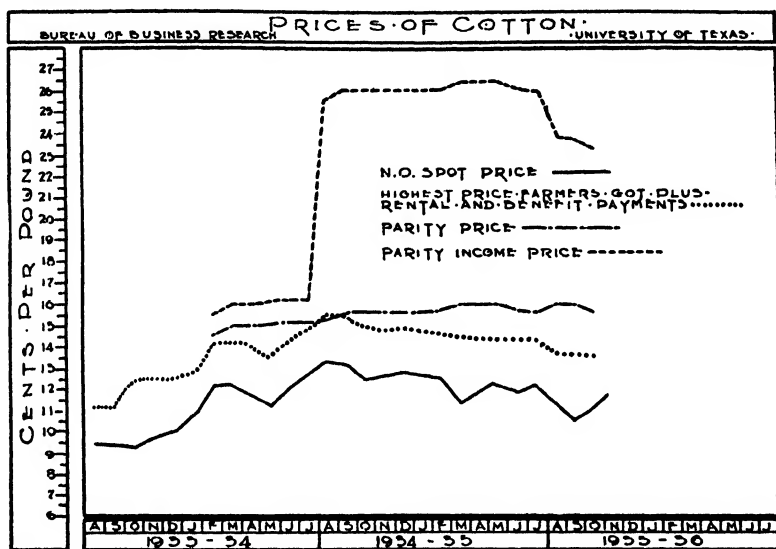


FIG. 3.

The New Orleans spot price, and the Government parity price need no further explanation. The price actually received by farmers is the actual price, the Government loan price or the guaranteed price whichever is higher, plus rental and benefits received by farmers converted to cents per pound on the basis of the amount of cotton produced.

Parity income price is a price times actual production which will give the cotton grower a total buying power equal to his average buying power for 1909-14. During the base period 1909-14 the average amount of cotton produced per cotton grower was about 8 bales. The average price was 12.4 cents per pound. This meant that the average cotton grower received \$496 for his cotton. Parity price is now 15.90 cents, and parity income is therefore \$636. The average farmer this year has grown only 5.1 bales. This means that each bale must bring \$124.72 to yield \$636 parity income, and to do that, the cotton grower must receive 24.94 cents per pound for his cotton. This year cotton

growers are receiving a guaranteed price of about 11.50 cents plus rental and benefit payments of about 2.00 cents on production, or a total of 13.50 cents which is only 54.1 per cent of parity income.

Doubtless some will question the validity of the parity income price. It will be argued that it costs the farmer less to produce 5 bales than 8, that he can use the released land for other crops not for sale. All that may be true, especially if one is considering only the landowner. On the other hand, it is absurd to base parity on anything other than income. This is especially true if the whole production complex is included such as the cotton growers, choppers, pickers, and ginner, as they should be. For fear that I shall be misunderstood as advocating parity income price for cotton growers equal to that of 1909-14, I wish to say that if the Government is going to presume to regulate and determine the relative incomes of different groups, I should like to protest the use of any fixed period as a base on the ground that it is unfair and illogical.

#### REASONS FOR FAILURE OF RESTRICTION PROGRAM

Aside from the fact that the restriction program typified by the A.A.A. and the Bankhead Act does not tackle the real problems of agriculture, as I shall discuss later, I wish at this juncture to point out three reasons for its immediate failure. They are: (1) rapid increase in foreign cotton production together with planned restriction of consumption of American cotton; (2) rapid increase in synthetic fiber production; and (3) impossibility of equitable administration of the control program.

*Supplies of American and World Cotton.* World supplies of American cotton have decreased more than 6,000,000 bales since 1932-33. Why is not that the cause of the advance in the dollar price of cotton? That is an important question and deserves careful analysis. Obviously, the answer is: because there has been no increase in the world gold price of cotton as shown by the gold price in Havre, Liverpool, and other world markets. Then are prices of cotton higher in gold in the United States than in foreign countries? No. If they were, no American cotton would be exported. Why have gold prices of American cotton not gone up? The explanation lies in a number of reasons. Only the major ones need be mentioned here. (1) While the supply of American cotton was being decreased by more than 6,000,000 bales, supplies of foreign cotton were being increased about 4,000,000 bales so that the net decline in supplies of all cotton has been less than 3,000,000 bales, and in spite of United States production this year being under 11,000,000 bales, world production is about 26,000,000 bales, or approximately what it was during the five years prior to the depression. American cotton

growers have thus reduced production about 13,400,000 bales in three years, but world supplies of all cotton were reduced about 2,800,000 bales only. Moreover, in spite of our drastic reduction, foreign production has been increased sufficiently to bring world annual production back to approaching normal. Has this been good business for American cotton growers? In 1933 the planners told us that foreign producers could not take our foreign markets; now they say that they would have taken them anyway. (2) Planned restriction of production of American cotton has been offset largely by planned restriction of consumption of American cotton. During the five pre-depression years, according to the figures of Garside of the New York Cotton Exchange, the average world consumption of American cotton was over 14,774,000 bales and all other cotton 9,986,000 bales. During the 1934-35 world consumption of American cotton was only 11,206,000 bales whereas world consumption of all other cotton was 14,222,000 bales. (3) The rapid increase in the production and consumption of foreign cotton is undoubtedly one of the greatest menaces to the advance in the gold price of cotton. Granting that the potential cotton production of the United States is still 15,000,000 bales or more, it is evident that world potential cotton production has been greatly increased since the inauguration of the control program. Recent figures from reliable sources show that foreign cotton production has been increased to more than 15,000,000 bales per annum. This means that world potential cotton production has been built up to over 30,000,000 bales, a figure far above normal consumption. (4) The program has created uncertainty which is one of the greatest deterrents to cotton consumption.

Figure 4 is a graphic presentation of figures published by John A. Todd of Liverpool, one of the best known authorities in the world on cotton crops. Todd's figures on foreign crops average about 600,000 bales above the figures of the U. S. Department of Agriculture. Todd's figures are used because United States figures for 1935-36 are not available. Special attention is called to the trend of production of American cotton as contrasted with foreign production.

*Rise of Artificial Fibers.* The rise in the production of artificial fibers undoubtedly offers the greatest menace to the cotton industry of the United States from a long-term viewpoint. It is a very serious fact and one that cotton growers should know that the world rayon and staple fiber production increased from 665,795,000 pounds in 1933 to 775,010,000 pounds in 1934. This increase is almost exactly equal to the annual increase in world cotton consumption over the past 25 years. It is highly important to realize that the greatest increases have occurred since the beginning of the cotton restriction program in 1933.

Figure 5 is a calculation I have made of the values of American and foreign crops of cotton in grains of gold. It is a striking illustration of the losses American cotton growers have sustained which the U.S. Government has forced them to hand over to foreign producers in the form of loss of markets. The chart is based on Todd's figures of production for each country, and the prices are averages calculated from

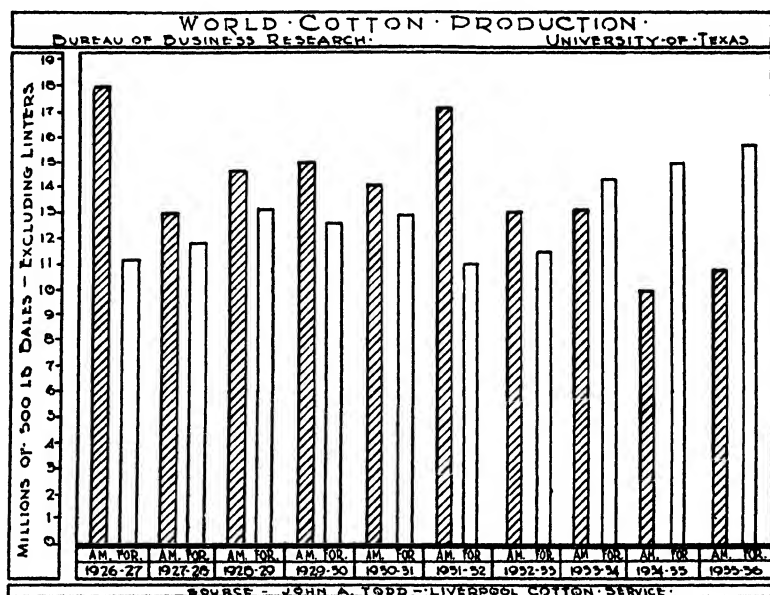


Fig. 4.

the Liverpool Weekly Circulars. Normally, the United States produced from 57 to 60 per cent of the world's cotton crops and cotton values. During the past three years, if we had gotten even 57 per cent of the value of the world's raw cotton production, the cotton growers of the South would have richer by about \$600,000,000 than they are, not counting rental and benefit payments. Cotton growers have received \$400,000,000 in rental and benefit payments and profit on cotton the Government sold them at below market price in 1933 to get them to plow up cotton. Stated in another way, this means that the United States is \$600,000,000 poorer, the cotton growers themselves \$200,000,000 poorer, and, what is more important, the cotton growers have lost a large market for their cotton.

How much has the cotton restriction program cost the cotton growers? No one will ever know exactly. As I have clearly shown already, it has been the important factor in causing us to lose foreign

market to the extent of about 3,000,000 bales annually. Moreover, consumption in the United States during the past year was down nearly 400,000 bales from the previous year. How much of this market will be permanently lost will depend on whether or not the Government sees fit to continue to restrict production and subsidize other fibers with a heavy processing tax on cotton.

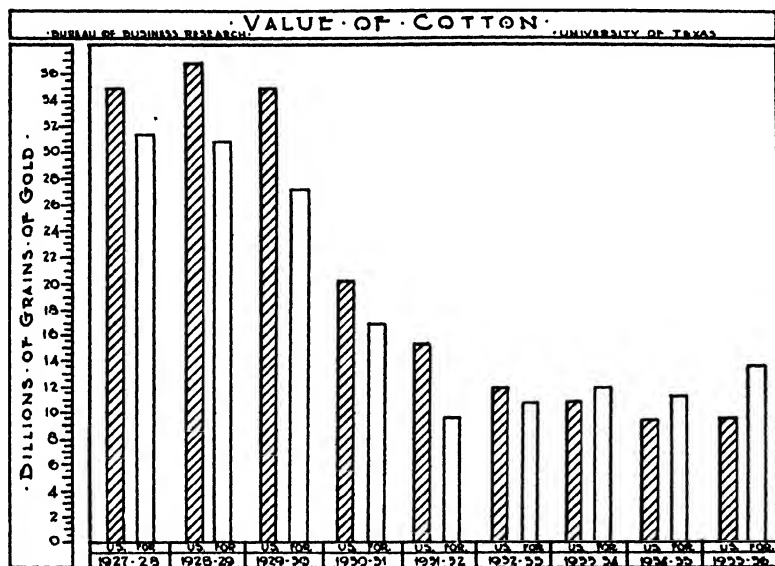


FIG. 5.

#### POSSIBILITY OF A RESTRICTION PROGRAM FOR THE FUTURE

What chance has the four-year cotton restriction program recently announced to raise prices and retrieve these losses? None. Before this do-less-and-get-more program was started the United States was producing from 57 to 60 per cent of the world's cotton. At that time a 30 per cent reduction in production in the United States accomplished a reduction of 18 per cent in world's cotton, a reduction of an additional 30 per cent in the United States would, at the same rate, reduce world production only 12 per cent. In the light of the facts already cited, is it not certain that another four years drastic restriction of cotton production, as already announced, will make even a 10,000,000-bale crop in the United States a surplus creating crop?

So much headline publicity has been given to the large sums of money turned loose by the Government to pay rental and benefit payments that most people think the cotton growers have been the recipients of unusual and especially copious bounties from the Federal

Government—that the cotton growers have been literally “paid off.” No greater injustice could be done a people than to permit that erroneous impression to be perpetuated.

The point I wish to emphasize is that the cotton growers of the United States have been done an almost irreparable injury. The devaluation of the dollar gave the cotton growers a bonus of 69.5 per cent, and that would have been ample to have put them in a relatively prosperous condition, strengthened their hold on their foreign markets, and, in addition, made the whole cotton industry prosperous. Unfortunately, for the farmers and for the country as a whole, that opportunity was taken away by the cotton restriction program of the A.A.A. and the Bankhead Act. As a result, the South's ability to sustain itself largely on the cotton industry has received a serious blow from the control program, and only heavy bonuses for increased production can bring it back to its former condition. Make no mistake, it will be a wise national policy to bring the South back at whatever cost because the burden cannot be localized in the South and the Southwest. It will be passed, in part, to other agricultural regions and to the industrial North and East in two important ways: first, in cutting off a large part of their market for their surplus product, and, second, in intense competition in production in both agriculture and industry. No amount of A.A.A., N.R.A., or other alphabetical restraints can stop it.

In view of the facts I have cited, will not history record the cotton restriction program of the United States as one of the greatest economic blunders ever committed by any people?

#### COTTON, THE KEY TO AGRICULTURAL AND INDUSTRIAL PROGRESS

The great strides in the United States which have been taken toward developing the highest standards of living of any country are a result of utilization of the country's abundant natural resources through division of labor in large scale production and regional specialization. Cotton has played the leading role in making possible specialized production on a large scale. Indeed, the development and growth of the cotton industry in the South gave direction to the economic development of the entire United States. The vehicle was the three-cornered trade centered around specialized production of cotton. In a very short space of time cotton became the world's greatest industrial raw material and commercial product and, as such, not only initiated regional specialization and large scale production in the United States but has been the most important factor in sustaining and developing specialized production to date. The South thus contributed the raw material

which played a leading part in the industrialization of Europe and New England and, with the cash received from raw cotton sold in these markets, bought the surplus food production of the Middle West. It was through this means that American agriculture was commercialized and permitted to develop on the basis of specialized regional production. Thus, our whole agricultural and industrial economy have been developed on the basis of individual and regional surplus production. Moreover, as has been pointed out by Mr. Elmer H. Johnson, my co-worker, the possibilities of adding to our standards of living by developing the possibilities of specialized regional production have been scarcely touched. The question now is, has the agricultural and industrial leadership in this country the vision to work out the necessary, smoothly coordinated, inter-regional relationships which will permit us to go ahead in this development?

The impasse confronting us now is not over-production about which there has been so much talk and little thought in recent months. There is not too much of cotton and cotton goods, wheat and bread, automobiles, electric refrigerators and other products, and never has been. The main problem, therefore, centers around the restoration of markets for regional surplus production. This involves two things: (1) the opening up of the inter-regional channels of trade at the place they are blocked, and (2) the restoration of equitable distribution of our national income as between regions and individuals.

Commercial cotton production not only paved the way for regional specialization of production in the United States, but the perpetuation of specialized cotton production or cash enterprise substitutes for it on an undiminished scale is essential to prevent the collapse of our system of regional production on its present scale. Certainly the easiest and surest way to prevent this threatened collapse is to restore foreign markets for American cotton to the extent of more than 50 per cent of our raw cotton production.

Do not be misled. This is not academic theory, and it is not strictly a cotton grower's problem. The extreme regional inter-dependence which has grown up makes it a national problem. The specialized wheat belt, the corn belt, the dairy regions, and the industrial centers in the North and East are in a very true sense as much or more interested in the restoration of cotton markets than the cotton growers themselves. To them it not only means a loss of a great market in the South but, in time, the development of formidable competitors.

Just how important is the export of raw cotton to our system of specialized regional production? Time will not permit a lengthy discussion of this question, and it is not necessary. Suffice it to say that



during the five pre-depression years the exports of cotton from the United States averaged about \$775,000,000 and that does not include exports of linters and cotton seed, and cotton seed products. This large sum brought in from abroad served as an effective spring to start a tremendous flow of goods which furnished the means for marketing all regional surpluses throughout the country. When that large volume of buying power from abroad is cut off and no adequate substitute is provided, the South will be forced into other types of agriculture and into more manufacturing, and no amount of repressive measures can stop it.

In view of these facts it is clear that the agricultural problems of the United States will not be solved until the cotton problem is solved, and cotton production restriction will not solve the cotton problem but will greatly complicate the problems of agriculture by further disrupting specialized regional production.

#### DISCUSSION

Public discussions of the Agricultural Adjustment activities of 1933-1935 are useful in so far as they contribute to a clearer understanding of the major problems involved. It is doubtful if clear understanding can be promoted unless we first recognize the emergency situation of 1932-33 and the practical measures that the situation demanded. A second requirement is a clear understanding of the A.A.A. objectives. A third requirement is an appreciation of the complex interrelations between prices, supplies, consumption, domestic and foreign demand with conclusions drawn from them that are the result of correct statistical and economic analyses. A fourth is adequate facts rather than guesses as to the effects on farmers and other groups; and a fifth requirement, perhaps more important than all the rest, is an unbiased attitude. Dr. Cox's paper on "The A.A.A., the Cotton Growers, and the Agricultural Problem" fails to meet these requirements.

Dr. Cox approaches his subject with an unmistakably biased unscientific attitude. I need only quote from the mimeographed copy of his paper which was distributed widely at the time it was delivered. In discussing the regional aspects of the agricultural programs, he writes:

"It (the A.A.A.) advises the cotton grower to use his surplus land to grow his own food and feed crops, the dairyman to grow his own feed, the corn belt feeder to put his surplus corn acreage into pasture, to grow his own feeder steers, and the ranchman to—well, since he did not see fit to join the program—to go to hell."

His principal theme is that the A.A.A. has been an utter failure since the world gold price of cotton in December 1935 was about the same as in April 1933. In this part of his argument, Dr. Cox not only misreads the price objective of the Agricultural Adjustment Act but fails to appreciate that gold prices for basic commodities have been depressed by the world-wide devaluation of currencies.

The purpose of the A.A.A. was not to raise world prices but to give farmers parity returns on domestic consumption and to let the balance of their production go at world prices. The higher price for domestically consumed production was to be given to producers in the form of benefit payments. In the case of cotton, the price objective was actually attained. The farm price of cotton in 1934 including the price equivalent of benefit payments was 9 per cent greater than the parity price and in 1935 it was 5 per cent greater.<sup>1</sup>

Dr. Cox also misreads the objectives of the A.A.A. in his references to planned curtailment of consumption. Consumption according to the Act was to be taxed, and processing taxes were not to be so large as to curtail consumption or cause stocks to pile up. As a matter of fact, the real consumption objective was to increase consumption by curtailing an excessive carryover, raising domestic prices and stimulating general business.

Like many others who have attempted to damn the A.A.A. by showing that devaluation of the dollar was the chief factor in raising domestic cotton prices, Dr. Cox stops short in his gold price analyses without observing two important dilemmas. One dilemma is created by his argument that 13.4 million bales of cotton have been kept out of production by the curtailment programs. He does not raise the question, how much lower would cotton prices be now if that much cotton, equal to one full crop, were added to the present supply? Statistical analyses of cotton prices, such as Dr. Cox does not resort to, show that the addition of one million bales of American cotton to the carryover lowers prices by  $\frac{3}{4}$  to 1 cent per pound. Assuming that lower prices would have prevailed during 1933-35 without the control programs, possibly 5 million bales of the additional 13.4 million might have been consumed. This would leave about 8 million bales to be added to the carryover of the present season, making a world carryover of American cotton of 18 million bales or four to five times normal—and cotton prices would probably be about 6 cents lower. The fact of the matter is of course that neither Dr. Cox nor anyone else knows how much cotton has been kept out of production, for no one knows what acreage reductions farmers would have made had the 17 million bale crop of 1933 been allowed to come onto the spot markets.

The other dilemma arises from the argument that the world gold price of cotton failed to rise in the face of curtailed production because of the expansion of foreign production and the "planned restriction of consumption of American cotton." If the world gold price has not been raised, whence comes the stimulus to foreign production? This problem suggests that the gold price does not now have the significance that Dr. Cox thinks it has and that the increase in foreign production is due to other factors that he has not taken into account. It is not the gold price of cotton but the currency price received by our farmers as compared with prices of other products that influences acreage, and it is not the gold price but the currency price

<sup>1</sup> See report on *Facts Relating to Cotton Prices and Purchasing Power* by L. H. Bean, A. A. A., August, 1935.

of cotton goods relative to prices of other products that influences consumption. This is true of the foreign cotton producing and consuming countries as well.

Those who, like Dr. Cox, dismiss the effect of the A.A.A. on cotton prices by referring to the low gold price fail to observe that cotton is not the only world commodity the price of which on a gold basis has remained practically unchanged. For example, the world gold price of wheat in Great Britain was only 6 cents higher in December 1935 than in April 1933, whereas the currency price was 41 cents higher. Dr. Cox cannot argue in this case that the reduction in the U. S. has been offset by an increase in foreign production, as he does with cotton. In fact, wheat production outside the U. S. was also reduced by weather and the excess in carryover has been reduced from 500 million bushels to nothing. Such failures as these of gold prices to rise in the face of reduced supplies and increased demand are clear indications that the general world-wide devaluation of currencies has altered the significance of gold as a measure of value. The problem is more complex than Dr. Cox indicates.

Foreign production has expanded but the reason for it is not predominantly the A.A.A. cotton program. This is revealed even by Dr. Cox's inadequate data and analysis. Dr. Cox presents an illustration showing an increase of 4 million bales of foreign production between the 1932-33 and the 1935-36 seasons. He does not point out that nearly 3 million bales of that increase occurred between the 1932-33 and the 1933-34 seasons, before the A.A.A. program adopted in the summer of 1933 was announced. The 1933-34 foreign acreage was the result of price conditions of the previous season and of other preceding factors. According to Dr. Cox's data, only about one-fourth of the increased foreign production he attributes to the A.A.A. occurred during the two years when the U. S. programs could have been responsible.

As a matter of fact, had Dr. Cox extended his illustration back to 1920 or earlier, it would have been clearer than in his chart from 1926 to 1935 that the recent increase in foreign production is only a continuation of a long-time persistent upward trend. One needs only project the prewar rate of expansion to see that without any A.A.A. programs, foreign production would have attained the volume that was actually produced in 1935. Another proof of this contention is contained in statistical analyses of foreign cotton acreage which enable us to determine how much of the increase in acreage is due to the price of cotton and how much to all other factors, such as the relatively low prices of coffee in Brazil and of grains and other competing crops in India and Egypt. We find that foreign cotton acreage expanded from 1921 to 1925 for reasons other than cotton prices, and that another period of expansion due to factors other than cotton prices began immediately with the onset of the depression after 1929. Had cotton prices remained unchanged during the last six years and had there been no A.A.A. programs, foreign acreage would have increased about as much as it actually did. Less than half of the increase in foreign acreage since 1933 can be

attributed to the higher currency price of American cotton and part of that higher currency price is due to other factors besides the A.A.A. programs.

Dr. Cox suggests that it should have been obvious from the beginning that foreigners would progressively increase production as the U. S. undertook to keep down supply. He fails, however, to recognize and to comment on the inevitability of that expansion regardless of what we did and to appreciate the necessity of helping the American cotton farmer and most of the other economic groups of the South cushion the shock of that expansion.

The other fact given by Dr. Cox for the A.A.A. failure to affect cotton prices, the rapid increase in synthetic fiber production, is even more inaccurate. He calls attention to "the serious fact" that world rayon and staple fiber production increased from 666 million pounds in 1933 to 775 million pounds in 1934 and then adds this entirely incorrect statement, "It is highly important to realize that the greatest increases have occurred since the beginning of the cotton restriction program in 1933." The increase between 1933 and 1934 was 109 million pounds but the previous increase, before the A.A.A. could have affected rayon production, was 139 million pounds. Furthermore, the increase between 1933 and 1934 was 16 per cent and the previous increase was considerably greater—26 per cent. The average annual increases in 1927, 1928 and 1929 of 28 per cent and in 1923, 1924 and 1925 of 35 per cent were also greater than the 1934 increase of 16 per cent.

Dr. Cox looks upon the cotton problem chiefly in terms of volume, and fails to see that there is a mid-point between abundant production that periodically about wrecks the South and unwise scarcity programs. The A.A.A. programs aimed at supplies more nearly in balance with demand conditions and eschewed the extremes of unwise scarcity and ruinous surpluses. A temporary curtailment of production to bring down a staggering carryover that kept prices low and business in the South close to a standstill in 1932-33, he considers is destruction of the processes of real wealth production. Over and over again the South, during the fifty years before the A.A.A., created "real wealth" in the form of bumper crops, and almost invariably these bumper crops gave the South and particularly the producers temporary economic set-backs. Actually, cotton farmers seldom realized "real wealth" from their bumper crops, the bulk of which went abroad at bargain prices or clogged up the economic machinery of the South in such a way as caused bank failures, increased indebtedness, and a perpetuation of low living standards. In 1926 cotton farmers produced "real wealth" in Dr. Cox's terms amounting to 18 million bales, a record crop, but received a gross return of about 500 million dollars less than in the previous year, and the cash left over after out-of-pocket expenses gave the average cotton producer a per capita purchasing power of only two-thirds of that of 1925 and two-thirds of his prewar standard of living. In 1931 the South again produced a large crop of 17 million bales. This time there was practically nothing left over after out-of-pocket expenses and the purchasing power per capita went down to about 12 per cent of what it had been in 1925 and before the war.

After this sort of "real wealth" production, the South has invariably curtailed its production so as to restore economic life in the South. In 1927 they reduced their acreage by 15 per cent, which together with a reduction in yields per acre brought about a larger gross and net income. All the other economic groups in the South profited from that improvement in values brought about by a curtailment in volume. Even those who depend on volume found they could move the large carryover from the 1926 crop much more freely at the higher prices of 1927-28 than at the low prices of 1926-27.

Similarly, in 1932 after the so-called real wealth of the large crop of 1931, farmers reduced their acreage and with reduced yields per acre only 13 million bales were produced. Even at the bottom of the depression in 1932 the income from the crop after out-of-pocket expenses was greater than the balance available from the large crop of 1931. On a small scale, in an unorganized way, farmers demonstrated in 1932 the wisdom of restraining production to permit the enormous carryover to come down to normal proportions. The prospect of a reduction in carryover as a result of the smaller crop and the resulting lift in cotton prices that the smaller 1932 crop brought about during the last half of 1932, were chiefly responsible for the temporary improvement in industrial activity after July 1932. Cotton consumption increased as prices were stimulated by the restrained production; 260,000 people were put back to work in the textile industry between July and October 1932, and weekly pay rolls were increased 7.5 million dollars. This was an increase of 35 per cent in employment and 64 per cent in pay rolls. In that brief period when the A.A.A. programs were being conceived, farmers themselves had demonstrated the nature of the practical approach to the cotton problem in the emergency of 1932-33, that was to be put into operation more effectively under Federal stimulus in 1933-35 to help bring about economic revival in the South and other parts of the country. The majority of farmers and the business interests of the South and other parts of the country dependent on the South are aware of the economic activity that has sprung up since 1932, even though like economists, statisticians, politicians and others, they are unable to appraise the separate influences on that revival that should be attributed to A.A.A., monetary devaluation, or other Federal as well as private activities.

Dr. Cox's prejudiced, loose and inaccurate references to the A.A.A. contribution to the unemployment and relief rolls of the South add more confusion than light. In one part of his paper he writes: "Hundreds of thousands of people in the South have been forced on to relief rolls as a result of production restriction"; in another, he writes that it "has put millions of people on relief." It is of course true that the A.A.A. dealt chiefly with production, but it attempted to prevent dismissal of tenants and share croppers by coöperating farmers, and it banked on the benefits to producers being generally distributed through the processes of trade, commerce and industry so that all groups of the South would share in economic revival. To what extent that was accomplished, cannot be determined. Dr. Cox, it is clear,

does not have any comprehensive data on displacement from farms and contributions to unemployment and relief, nor does anyone else. In a recent report by the Bureau of Agricultural Economics on this question, at the request of the Secretary of Agriculture, the Bureau was unable to draw any general conclusions because a basis for such conclusions does not exist. Conclusions based on inadequate samples may serve journalistic purposes but they do not add to balanced understanding.

There are two sources of data that throw only partial light on this question of increased relief rolls and tenant displacement, the Federal Emergency Relief Administration and the Bureau of the Census. According to the reports of the F.E.R.A. the number of people on relief in August 1933 constituted 12 per cent of the population. The relief load was also 12 per cent in Texas, but 14 per cent in Mississippi, 15 per cent in Louisiana, 18 per cent in Arkansas and Alabama, 20 per cent in South Carolina and 27 per cent in Oklahoma. This was the situation before the A.A.A. programs of 1933, 1934 and 1935 could have had any effect on the relief situation. In August 1935 the relief load for the country as a whole, after increasing during 1934, was again 12 per cent of the total population but it was relatively lighter in the cotton producing states than in 1933. In the two-year period the percentage for Texas, where Dr. Cox says the relief problem is still a staggering one, fell from 12 to 10; for Mississippi from 14 to 8; for Louisiana from 15 to 10; in Arkansas from 18 to 11; in Alabama from 18 to 10; in South Carolina from 20 to 8; and in Oklahoma from 27 to 19.

The 1935 census data reveal some striking changes in tenure between 1930 and 1935, but it is impossible to determine from that source alone how much of these changes took place between 1929 and 1933 and how much during 1933-35. For ten of the cotton states there was a reduction of about 31,000 in the number of white croppers, but an increase of about 106,000 in white tenants other than croppers or a net increase of 75,000 in white tenants. In addition, there was an increase of about 96,000 in the number of white owner-operators. Among the colored farmers, there was a decrease in croppers amounting to about 22,000 and in tenants other than croppers of about 47,000 or a total decrease of 69,000. Unbiased students of the South believe that a very large part of this shift among the colored tenants took place during the severest years of this depression, 1931 and 1932, when the cotton crops returned practically nothing after paying out-of-pocket costs. For the South as a whole, there were about 160,000 more farm owner-operators in 1935 than in 1930 and about 40,000 more tenants.

Dr. Cox's estimates of losses to other groups due to reduced volume are even less reliable than his estimate of the total reduction in production upon which they are apparently based. In the first place, the volume of business "lost" cannot be determined unless we know what farmers would have done without the 1933-34-35 programs. Secondly, he does not take into account losses that certainly would have resulted if carryover had been allowed to pile up even higher and perpetuate a low price structure in the South for cotton, for land, for wages and other services.

Dr. Cox has attempted to do in his paper "The A.A.A., the Cotton Growers, and the Agricultural Problem" what unbiased scholars and technically trained statisticians and economists are going to do more successfully during the next few years. After 1936 there will probably be a much smaller market for hasty and exaggerated criticism of the A.A.A. cotton program, just as there will be little need for exaggerated claims for its beneficial effects.

L. H. BEAN

U. S. Department of Agriculture

### REJOINDER

Mr. Bean's opinion of me neither answers my arguments nor lessens the force of the facts presented. He involves himself in a maze of undigested figures and then says: "It (the cotton problem) is more complex than Dr. Cox indicates." My reply is that often-times a thing seems complicated to one merely because he does not understand it.

Limited space allotted permits me to deal only with major issues.

*The main Theses in my paper are:*

- (1) That parity price with 1909-1914, which is the main objective of the A.A.A., is unsound and that parity income should be the objective.
- (2) That the gold price of cotton has not advanced, and that dollar prices advanced almost exactly in proportion to the decline in the gold value of the dollar.
- (3) That a restriction program to raise price to raise farmers income will not work in the case of cotton because planned restriction of production is met by (a) planned restriction of consumption of American cotton, (b) planned expansion of production abroad, and (c) increased competition of substitutes.
- (4) That cotton production restriction has put hundreds of thousands, even millions, on relief.
- (5) That specialized cotton production occupies a key position in our system of specialized, large scale, regional production, and that it is of extreme national importance to restore foreign markets for American cotton.

(1) *Parity Price and Parity Income.* In his attempt to dodge the force of the facts I presented on parity prices and income Mr. Bean did the very unusual thing of making an interpretation of the purposes of the A.A.A. wholly unwarranted by the law and at variance with its universal interpretation. He said the purpose was "to give farmers parity returns on domestic consumption and let the balance of their production go at world prices." Does Mr. Bean realize what he has said? If this was the purpose of the law, the Department of Agriculture misled the farmers and Congress is grossly ignorant of what it had done.

Let us analyze Mr. Bean's statement into figures. Parity return on domestic consumption cannot mean anything other than parity price times

domestic consumption. During 1934-1935, e.g. domestic consumption was 5,360,000 bales. Thus the domestic allotment would be about  $2\frac{1}{2}$  bales on the average. Parity price times this allotment would be approximately \$200. The remaining 2.6 bales of the average production per farmer in 1934-1935 brought the farmer about \$150 a total income justified under A.A.A. from lint cotton of about \$350, according to Mr. Bean. If he bases parity consumption on the period 1909-1914 instead of 1934-1935 it would be even less. Remember the cotton grower got an average of about \$496 annually out of lint cotton during 1909-1914. I am sure few Congressmen and no cotton growers would agree with Mr. Bean. To show that I have not misinterpreted his statement note this. He said: "In the case of cotton, the price objective was actually attained. The farm price of cotton in 1934 including the price equivalent of benefit payments was 9 per cent greater than parity price." Now if you apply all rental and benefit payments in price equivalents to domestic consumption alone you get a price approximately 9 per cent above parity price.

(2) *The Gold Price of Cotton.* Mr. Bean does not deny the validity of my thesis Number 2. He tries to establish an alibi by saying prices would have gone much lower had it not been for the A.A.A. At this point he presents what he calls two dilemmas. To present the first he asks, how much lower prices would have gone had we produced the extra 13.4 million bales. His answer is 6 cents which would make cotton worth now 5 cents in our "streamlined dollar" or less than 3 cents in terms of the old dollar. My answer is, I do not know. My guess is we would not have produced that many extra bales, foreigners would have produced less, there would have been fewer substitutes, some increased consumption, and the price slightly lower.

The second dilemma is "if world gold price has not been raised, whence come stimulus to foreign production?" My answer is, we virtually gave foreigners a guaranteed price and market by our restriction program and Government loans above market price; depreciated currencies in cotton growing countries helped, and United States tariff barriers, bi-lateral trade agreements along with other things, played a part.

(3) *Restriction Program.* Reasons for failure of planned scarcity program. I argued; (a) The theory of planned scarcity is based on the false premise that planned short crops and random short crops are comparable. Mr. Bean did not get the point. Planned restriction of production of cotton in the United States was met by planned restriction of consumption of American cotton. Mr. Bean's reply is that the A.A.A. did not plan decreased consumption. No, but the spinners of the world did. In this connection he makes the naïve statement that the A.A.A. planned increased consumption by using the processing tax to curtail excessive carryover, raise domestic prices, and stimulate general business. It was a wonderful plan but as the following figures show it did not work. During the year 1934-1935 United States cotton consumption was down 340,000 bales from the previous year and 777,000 bales from the year before even though we were supposed to be coming out of the depression. Foreign consumption of American cotton was



even worse. It dropped from 7,981,000 in 1933-1934, to 6,098,000 bales in 1934-1935. A slight miscarriage of plans I would say.

Mr. Bean says cotton consumption rose after July, 1932, because the farmers curtailed production at the same time the brilliant idea of "*do less to get more*" was being conceived. In the first place, in July it is impossible to tell what the new crop will be, and in the second place to imply that vague ideas of A.A.A. in the minds of a few people detached from business and ten months before enactment should have such potency is putting it rather strongly to say the least. Mr. Bean's argument at this point is really a marvelous piece of mental gymnastics. It shows what one with a fertile imagination, few first-hand facts, and no understanding of the economic processes he is discussing can do. It is a shame to explode his theory. Nevertheless, it must be done. The fact is the foundation for the revival of cotton manufacturing Mr. Bean speaks of was laid in the low prices of cotton in the winter of 1931 and the spring of 1932. About this I am not guessing; throughout the whole period I gathered from merchants every fifteen days their sales of cotton for delivery in forward month both to domestic mills and to export. By July, 1932, domestic mills and foreign importers had bought more cotton for summer and early fall delivery than for any similar period since 1926, another period very similar. This favorable situation in the cotton industry laid on the foundation of cheap cotton coincided with other factors favorable to the revival of business both in this country and abroad.

(b) Planned expansion of production abroad. Mr. Bean's only answer is what I said it would be "foreigners would have done it anyway," even though in 1933 it was said they could not do it. He said I did not go far enough back with my statistics on foreign production. He suggested 1920, so, to 1920 we go. The straight line trend of foreign production based on the period 1920 through 1932-1933 or down to the period under discussion shows that foreign production for 1935-1936 should have been 13,170,000 bales; it was actually over 15,000,000. Trends in United States production over the same period show United States production in 1935-1936 should have been 17,065,000 bales; it was 10,417,000. The trends from 1890 show the same relative growth. The only way I can imagine that Mr. Bean came to the conclusion he did was that he did the unscientific thing of including the last three years in his calculations when the United States farmers were "tied down" and our Government gave foreign producers the equivalent of a guaranteed price.

(c) Increased competition of substitutes. Mr. Bean says I am inaccurate and incorrect in my analysis. He bases his indictment on a misstatement of fact and the use of very false statistical practice. There was, as he points out, a 139 million pounds increase in rayon production in 1933 over 1932. His error was in thinking that was prior to the restriction program. The fact is, of course, the increase occurred in 1933 and that was the year the cotton processing tax was put on and the "cotton plow-up" occurred so that it was very much a year of restriction. In no year prior to 1933 did increased production reach 100 million pounds.

Those who know Mr. Bean will be surprised to find him presenting an argument based on percentage comparisons where each percentage is calculated on a different base. For example, he points out that the percentage increase in rayon production in 1925 over 1924 was 35 per cent, as against 16 per cent increase in 1934 over 1933. Now, the 35 per cent increase in 1925 over 1924 represented only 15.6 million pounds, whereas the 16 per cent in 1935 represented 109 million pounds. Surely Mr. Bean knows that this sort of comparison is incorrect, and yet there it is.

(4) *About Relief.* Mr. Bean characterizes my statements as "prejudiced, loose, and inaccurate." Unfortunately, at that time I had to talk in general terms as to numbers on relief and please note I used general expressions to make that plain. It seems the Government has been rather hesitant in gathering and publishing data on the number of unemployed, the number receiving Government relief, and why. I have been told that the Bureau of Agricultural Economics made a study of the A.A.A., and among other things its effects on employment in cotton production and came to the conclusion that there were 983,000 fewer men used in the production of the 1934-1935 crop than on an average during 1928-1932. Unfortunately, that figure was later censored out of the report by the A.A.A., and yet Mr. Bean says I am prejudiced and blames me for not giving exact figures. He says the number on relief has been decreased. Yes, nominally but how? Because the great mass of unemployed were ordered taken off relief and put on so called work projects.

A. B. Cox

# ERRORS OF THE SECOND KIND IN TESTING "STUDENT'S" HYPOTHESIS

BY J. NEYMAN AND B. TOKARSKA

CONSIDER a normally distributed variate  $x$  having the population mean,  $a$ , and the population standard error,  $\sigma$ . The probability law for  $x$  will, therefore be

$$(1) \quad p(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-(x-a)^2/2\sigma^2}.$$

Assume that certain observations are able to provide us with a single value of the variate  $x$  and also with the estimate of  $\sigma^2$ , say  $s^2$  independent of  $x$  and based on  $n$  degrees of freedom. Suppose further that we do not have any *a priori* information about the values of either  $a$  or  $\sigma$  but that we wish to test a hypothesis, say  $H_0$  that  $a=a_0$  while the value of  $\sigma$  is more or less indifferent to us. The hypothesis  $H_0$  thus stated is called "Student's" hypothesis.<sup>1</sup>

It will be useful to distinguish two special forms of "Student's" hypothesis.

(1) *Symmetrical Form.* Here we ask simply whether  $a=a_0$  and should like to detect any difference between the true value of  $a$  and the hypothetical one,  $a_0$ , whether  $a < a_0$  or  $a_0 < a$ . In this case the hypothesis tested, say  $H_s$ , assumes that  $a=a_0$  while the set of admissible alternatives contains any hypothesis ascribing to  $a$  a value other than  $a_0$ .

(2) *Asymmetrical Form.* The question asked here may be either (a) Is the true value of  $a \leq a_0$ ? or (b) Is the true value of  $a \geq a_0$ ? The cases (a) and (b) are clearly analogous and therefore we shall consider more closely only the first. Mathematically the problem is reduced to that of testing a hypothesis, say  $H_a$ , assuming that  $a \leq a_0$  while the set of admissible alternatives contains only such hypotheses which ascribe to  $a$  the values  $a > a_0$ .

In practical problems it is the asymmetrical form that is most frequently met with. This may be illustrated by the following examples.

*Example I.* A large brewery recommends to farmers a special variety of barley, say variety  $V_0$ . A breeder recommends a certain new variety, say  $V_1$ , which in his opinion is able to give a larger average value of a character  $X$  desirable for the brewery. The brewery may like to carry out experiments to test the advantages of the two varieties  $V_0$  and  $V_1$ . Denote by  $\xi_0$  and  $\xi_1$  the population means of the character  $X$

<sup>1</sup>"Student": "On the Probable Error of the Mean," *Biometrika*, Vol. VI, 1908, pp. 1-25.

corresponding to the varieties  $V_0$  and  $V_1$  respectively and by  $a$  the difference

$$(2) \quad a = \xi_1 - \xi_0.$$

If  $a \leq 0$  i.e. if  $\xi_1 \leq \xi_0$  then there will be no reason for the brewery for substituting the new variety  $V_1$  instead of the established standard  $V_0$ . On the other hand, if the experiment provides sufficient evidence that actually  $a > 0$  i.e. that  $\xi_0 < \xi_1$  it may be worth while to recommend the variety  $V_1$  instead of  $V_0$ . The hypothesis to test is therefore that  $a \leq 0$  while the alternatives assume that  $a > 0$ .

*Example II.* A buyer agrees to accept a large consignment of electric lamps at a fixed price on the assumption that the average length of life of the lamps, say  $a$ , exceeds a certain limit  $a_0$ . To test this circumstance a sample of several lamps is analysed and it is seen that the question asked is reduced to the test of an asymmetrical hypothesis, namely that  $a \leq a_0$  the alternatives being  $a_0 < a$ . The consignment is accepted when the trial of a sample of lamps furnishes sufficient evidence for the rejection of the hypothesis tested.

The tests of both symmetrical and asymmetrical forms of "Student's" hypothesis are based on the same criterion,

$$(3) \quad t = (x - a)/s$$

and in both cases we may conveniently use the tables provided by R. A. Fisher.<sup>2</sup> These tables give the values of  $t$ , say  $t_P$ , such that the probability of getting by chance a value of  $t$  within the limits  $-t_P < t < t_P$  is equal to  $1 - P$ . The test of the symmetrical hypothesis  $H_s$  consists now in a rule of accepting  $H_s$  when the observed value of  $t$  is such that  $|t| < t_P$  and in rejecting  $H_s$  in other cases, i.e. when  $|t| \geq t_P$ . It has been shown by Neyman and Pearson<sup>3</sup> that the probability of unjustly rejecting a true hypothesis when applying this rule cannot exceed the value  $P$ , which can be chosen in advance.

The test of asymmetrical hypothesis  $H_a$  is similar. We reject  $H_a$  when the observed value of  $t$  is greater than  $t_P$  and we accept  $H_a$  in other cases. The difference consists in that  $H_s$  is rejected both when  $-t \geq t_P$  and when  $t \geq t_P$  while  $H_a$  will be rejected only if  $t \geq t_P$ . The consequence of this is that the probability of a false rejection of an asymmetrical hypothesis,  $H_a$ , when comparing the observed value of  $t$  with  $t_P$  will be smaller and could not exceed the limit  $\frac{1}{2} P$ .

Errors that consist of the unjust rejection of a hypothesis are called errors of the first kind. Those that consist of the acceptance of a

<sup>2</sup> R. A. Fisher: *Statistical Methods for Research Workers*, London, 1934.

<sup>3</sup> J. Neyman and E. S. Pearson: (a) "On the Use and Interpretation of Certain Test Criteria . . ." *Biometrika*, Vol. XX-A, 1928, pp. 175-240 and 264-294; (b) "The Testing of Statistical Hypotheses in Relation to Probabilities *a priori*," *Proc. Camb. Phil. Soc.*, Vol. XXIV, 1933, pp. 492-510.

hypothesis when it is in fact false are called errors of the second kind. Usually the tests are so arranged as to have a certain fixed limit, say  $\alpha$  which the probabilities of first kind errors could not exceed. This limit could be such as  $\alpha=0.05$ ,  $\alpha=0.01$ , etc. Assume that the number  $\alpha$ , which we shall call the level of significance, is fixed. Then if we test a symmetrical "Student's" hypothesis,  $H_a$ , we should use  $t_P$  corresponding to  $P=\alpha$ . On the other hand, when we test the "Student's" hypothesis in its asymmetrical form, then we should use  $t_P$  corresponding in Fisher's tables to  $P=2\alpha$ .

Let us now consider more closely the errors of the second kind and their probabilities. Their importance as a basis for a rational choice among possible criteria to test a hypothesis has been recognized for some time. The first table of the probabilities of errors of the second kind in testing "Student's" asymmetrical hypothesis was published by St. Kołodziejczyk.<sup>4</sup> A somewhat fuller table appeared last year.<sup>5</sup> Since then it has become evident that the rational planning of experiments to be dealt with statistically requires a table somewhat different in form from those already published. Such a table is provided in the present publication. This table, as well as the two mentioned above, has been calculated in the joint Laboratories, the Biometric Laboratory, Nencki Institute, and the Statistical Laboratory, Central College of Agriculture, Warsaw. All the tables deal with probabilities of errors of the second kind in testing "Student's" hypothesis in its asymmetrical form.

As we have mentioned, an error of the second kind occurs when we accept the hypothesis tested  $H_a$ , say that  $a \leq a_0$ , while it is false and thus the true value of the population mean  $a = a_1 > a_0$ . It is obvious that both the importance and the probability of such errors must depend upon the value of the difference  $a_1 - a_0 = \Delta$  (say). The larger the difference  $\Delta$ , the more important it is to avoid the acceptance of  $H_a$  and, all other things being equal, the smaller is the probability of accepting  $H_a$ . It follows easily from the usual "normal theory" that the probability  $P_{II}$  of accepting  $H_a$  when the true value of  $a = a_1$ , is given by the integral

(4)

$$P_{II} = \frac{n^n}{\sigma^{n+1}\sqrt{2\pi}} \frac{1}{2^{(n-1)/2} \Gamma(\frac{1}{2}n)} \int_0^\infty s^{n-1} e^{-ns^2/2\sigma^2} \cdot \int_{-\infty}^{s_0+ts} e^{-(x-a_1)^2/2\sigma^2} dx ds$$

<sup>4</sup> St. Kołodziejczyk: "Sur l'erreur de la seconde catégorie dans le problème de 'Student'," *Comptes Rendus of the Paris Academy*, Vol. 197, 1933, p. 814.

<sup>5</sup> J. Neyman with co-operation of K. Iwaaskiewicz and St. Kołodziejczyk: "Statistical Problems in Agricultural Experimentation," *Supplement to the Journal of the Royal Statistical Society*, Vol. II, Part II, 1935, pp. 107-130.

which reduces to

$$(5) \quad P_{II}(\alpha, \rho) = \left(\frac{n}{t}\right)^n \frac{1}{2^{(n-1)/2} \Gamma(\frac{1}{2}n)} \int_0^\infty v^{n-1} e^{-nv^2/2t^2} \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{v-\rho} e^{-u^2/2} du dv$$

where

$$(6) \quad \rho = (a_1 - a_0)/\sigma = \Delta/\sigma$$

may be called the standardized size of the error of the second kind, and  $t = t_P$  is taken from Fisher's table so as to correspond to the chosen level of significance  $\alpha$ . In Fisher's table,  $P = 2\alpha$ .

All the three tables mentioned were computed by calculating the integral (5) by Weddle's formula for different values of  $n$  and  $\rho$  and by backward interpolation.

The present table differs from the others in that it gives the values of  $\rho$ , the standardized size of the error of the second kind corresponding to fixed values of  $P_{II}(\alpha, \rho)$ ,  $\alpha$  and  $n$ , while in other tables  $\rho$  was considered as an independent variable. In other words, the other tables give the answer to the question: What is the chance of accepting the hypothesis  $H_a$  that  $a \leq a_0$  when the true value of  $a$  is  $a_1 = a_0 + \rho\sigma$ ?

On the other hand the present tables answer the question: What is the standardized size of the difference  $\Delta$  between the true population mean  $a_1$  and the hypothetical upper limit  $a_0$  which will be undetected with the given frequency  $P_{II}$ ?

The present tables are divided into two parts, Table I and Table II corresponding to the levels of significance  $\alpha = 0.05$  and  $\alpha = 0.01$ . Rows in each table correspond to different values of the number of degrees of freedom  $n$  and the columns to several fixed values of the probability of errors of the second kind.

The use of the tables may be illustrated by the following two examples.

*Example III.* A breeder of new varieties of cereals considers the layout of an experiment in which he desires to compare a new variety,  $V_1$ , with an established standard  $V_0$ . Let  $\xi_0$  and  $\xi_1$ , denote the true mean yields of the standard and the variety tested per some unit of area. The breeder will have to test the hypothesis  $H_a$  that  $\Delta = \xi_1 - \xi_0 \leq 0$  and will consider his problem of producing a better variety as successfully accomplished whenever he gets the evidence that the hypothesis is not true and therefore that  $\xi_1 > \xi_0$ . Assume that the level of significance is  $\alpha = 0.01$ , so that the breeder desires to reduce the probability of his unjust rejection of the hypothesis tested to a level not exceeding  $\alpha = 0.01$ . Suppose further that the experiment planned originally as-

TABLE I— $P_{II}$  ( $\alpha=0.05$ )

THE QUANTITY TABLED IS THE STANDARDIZED ERROR OF THE SECOND KIND,  $\rho$ , WHICH WILL BE COMMITTED WITH THE RELATIVE FREQUENCY  $P_{II}$ , IF THE ESTIMATE OF STANDARD ERROR IS BASED ON  $n$  DEGREES OF FREEDOM AND IF THE LEVEL OF SIGNIFICANCE ASSUMED IS  $\alpha=0.05$ .

$n$	0.01	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
1	16.46	12.63	10.51	8.19	6.63	5.38	4.31	3.35	2.46	1.60	0.64
2	6.88	5.52	4.81	3.98	3.40	2.92	2.49	2.07	1.63	1.15	0.50
3	5.47	4.46	3.93	3.30	2.85	2.48	2.13	1.79	1.43	1.02	0.45
4	4.95	4.07	3.60	3.04	2.64	2.30	1.99	1.67	1.34	0.96	0.43
5	4.70	3.87	3.43	2.90	2.53	2.21	1.91	1.61	1.29	0.92	0.42
6	4.55	3.75	3.33	2.82	2.46	2.15	1.86	1.57	1.26	0.90	0.41
7	4.45	3.67	3.26	2.77	2.41	2.11	1.82	1.54	1.24	0.89	0.40
8	4.38	3.62	3.21	2.73	2.38	2.08	1.80	1.52	1.22	0.88	0.40
9	4.32	3.58	3.18	2.70	2.35	2.06	1.78	1.50	1.21	0.87	0.39
10	4.28	3.54	3.15	2.67	2.33	2.04	1.77	1.49	1.20	0.86	0.39
11	4.25	3.52	3.13	2.66	2.32	2.02	1.75	1.48	1.19	0.86	0.39
12	4.22	3.50	3.11	2.64	2.30	2.01	1.74	1.47	1.19	0.85	0.38
13	4.20	3.48	3.09	2.63	2.29	2.00	1.74	1.47	1.18	0.85	0.38
14	4.18	3.46	3.08	2.62	2.28	2.00	1.73	1.46	1.18	0.84	0.38
15	4.17	3.45	3.07	2.61	2.27	1.99	1.72	1.46	1.17	0.84	0.38
16	4.16	3.44	3.06	2.60	2.27	1.98	1.72	1.45	1.17	0.84	0.38
17	4.14	3.43	3.05	2.59	2.26	1.98	1.71	1.45	1.17	0.84	0.38
18	4.13	3.42	3.04	2.59	2.26	1.97	1.71	1.45	1.16	0.83	0.38
19	4.12	3.41	3.04	2.58	2.25	1.97	1.71	1.44	1.16	0.83	0.38
20	4.12	3.41	3.03	2.58	2.25	1.97	1.70	1.44	1.16	0.83	0.38
21	4.11	3.40	3.03	2.57	2.24	1.96	1.70	1.44	1.16	0.83	0.38
22	4.10	3.40	3.02	2.57	2.24	1.96	1.70	1.44	1.16	0.83	0.37
23	4.10	3.39	3.02	2.56	2.24	1.96	1.70	1.43	1.15	0.83	0.37
24	4.09	3.39	3.01	2.56	2.23	1.95	1.69	1.43	1.15	0.83	0.37
25	4.09	3.38	3.01	2.56	2.23	1.95	1.69	1.43	1.15	0.83	0.37
26	4.08	3.38	3.01	2.55	2.23	1.95	1.69	1.43	1.15	0.82	0.37
27	4.08	3.38	3.00	2.55	2.23	1.95	1.69	1.43	1.15	0.82	0.37
28	4.07	3.37	3.00	2.55	2.22	1.95	1.69	1.43	1.15	0.82	0.37
29	4.07	3.37	3.00	2.55	2.22	1.94	1.68	1.42	1.15	0.82	0.37
30	4.06	3.37	2.99	2.54	2.22	1.94	1.68	1.42	1.15	0.82	0.37
$+\infty$	3.97	3.29	2.93	2.49	2.17	1.90	1.64	1.39	1.12	0.80	0.36

TABLE II— $P_{II}$  ( $\alpha=0.01$ )

THE QUANTITY TABLED IS THE STANDARDIZED ERROR OF THE SECOND KIND,  $\rho$ , WHICH WILL BE COMMITTED WITH THE RELATIVE FREQUENCY  $P_{II}$ , IF THE ESTIMATE OF STANDARD ERROR IS BASED ON  $n$  DEGREES OF FREEDOM AND IF THE LEVEL OF SIGNIFICANCE ASSUMED IS  $\alpha=0.01$ .

$n$	0.01	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
1	82.00	62.40	52.37	40.80	33.00	26.79	21.47	16.70	12.27	8.07	4.00
2	15.22	12.26	10.74	8.96	7.73	6.73	5.83	4.98	4.12	3.20	2.08
3	9.34	7.75	6.87	5.87	5.17	4.59	4.07	3.56	3.03	2.44	1.66
4	7.52	6.28	5.64	4.88	4.34	3.88	3.47	3.06	2.63	2.14	1.48
5	6.68	5.62	5.07	4.41	3.93	3.54	3.17	2.81	2.42	1.98	1.38
6	6.21	5.25	4.74	4.13	3.70	3.33	2.99	2.66	2.30	1.88	1.32
7	5.91	5.01	4.53	3.96	3.55	3.20	2.88	2.56	2.22	1.82	1.27
8	5.71	4.84	4.39	3.84	3.44	3.11	2.80	2.49	2.16	1.77	1.24
9	5.56	4.72	4.28	3.75	3.36	3.04	2.74	2.43	2.11	1.74	1.22
10	5.45	4.63	4.20	3.68	3.31	2.99	2.69	2.39	2.08	1.71	1.20
11	5.36	4.56	4.14	3.63	3.26	2.94	2.65	2.36	2.05	1.69	1.18
12	5.29	4.50	4.09	3.58	3.22	2.91	2.62	2.33	2.03	1.67	1.17
13	5.23	4.46	4.04	3.55	3.19	2.88	2.60	2.31	2.01	1.65	1.16
14	5.18	4.42	4.01	3.51	3.16	2.86	2.57	2.29	1.99	1.64	1.15
15	5.14	4.38	3.98	3.49	3.14	2.84	2.56	2.28	1.98	1.63	1.14
16	5.11	4.35	3.95	3.47	3.12	2.82	2.54	2.26	1.97	1.62	1.14
17	5.08	4.33	3.93	3.45	3.10	2.80	2.53	2.25	1.96	1.61	1.13
18	5.05	4.31	3.91	3.43	3.08	2.79	2.51	2.24	1.95	1.60	1.13
19	5.03	4.29	3.89	3.41	3.07	2.78	2.50	2.23	1.94	1.60	1.12
20	5.01	4.27	3.88	3.40	3.06	2.77	2.50	2.22	1.93	1.59	1.12
21	4.99	4.25	3.86	3.39	3.05	2.76	2.49	2.22	1.93	1.59	1.12
22	4.97	4.24	3.85	3.38	3.04	2.75	2.48	2.21	1.92	1.58	1.11
23	4.96	4.23	3.84	3.37	3.03	2.74	2.47	2.20	1.91	1.58	1.11
24	4.94	4.21	3.83	3.36	3.02	2.73	2.47	2.20	1.91	1.57	1.11
25	4.93	4.20	3.82	3.35	3.02	2.73	2.46	2.19	1.90	1.57	1.10
26	4.92	4.20	3.81	3.34	3.01	2.72	2.45	2.19	1.90	1.57	1.10
27	4.91	4.19	3.80	3.34	3.00	2.72	2.45	2.18	1.90	1.56	1.10
28	4.90	4.18	3.79	3.33	3.00	2.71	2.44	2.18	1.89	1.56	1.10
29	4.89	4.17	3.79	3.32	2.99	2.71	2.44	2.17	1.89	1.56	1.09
30	4.88	4.16	3.78	3.32	2.99	2.70	2.44	2.17	1.89	1.55	1.09
$+\infty$	4.65	3.97	3.61	3.17	2.85	2.58	2.33	2.07	1.80	1.48	1.04

sumes that each of the varieties  $V_0$  and  $V_1$  (among some others) will be replicated say  $n'=8$  times, and that the number of degrees of freedom on which the estimate of the standard error will be based will be  $n=14$ . According to previous experience the standard error of any single yield is expected to be say  $\sigma_0=6$  per cent of the general mean yield. Having all these data the experimenter will be naturally interested in the size of differences between the mean yields of varieties  $V_0$  and  $V_1$  (in favour of the new variety  $V_1$ ) which he is likely to detect in his experiment in case they in fact exist. It is in fact obvious that the new variety may be better than the standard,  $V_0$ , but owing to the random variation its advantage may remain undetected. The answer to the question asked is contained in Table II in the row corresponding to  $n=14$ , which gives the standardized second kind error  $\rho$  corresponding to several values of the probability  $P_{II}$ . The difference  $\Delta$  will be estimated by the difference, say  $\delta = \bar{x}_1 - \bar{x}_0$  of the mean yields of two varieties  $V_0$  and  $V_1$  from eight plots each. The standard error of  $\delta$  will be  $\sigma = \sigma_0\sqrt{2/n'}$  or, in this case,  $\sigma = 3$  per cent of the general mean yield. Now  $\Delta = \rho\sigma = 3\rho$  per cent of the general mean. Substituting the figures in the row  $n=14$  of Table II instead of  $\rho$  in the above formula we shall get the following result describing the efficacy of the experiment planned:

TABLE A. LEVEL OF SIGNIFICANCE  $\alpha=0.01$

Size of real difference in average yields in percentage of the average yield	15.54	13.26	12.03	10.53	9.48	6.87	5.97	4.92	3.45
Chance of non-detection	0.01	0.05	0.10	0.20	0.30	0.60	0.70	0.80	0.90

In other words, if the true excess in the average yield of variety  $V_1$  over that of the standard variety  $V_0$  is as large as 15.54 per cent of the general mean yield, then the experiment described will fail to detect this difference only in 1 per cent of cases. If the true difference in yields is about 13.26 per cent of the general mean, then the chance of its being not detected by the experiment is 0.05, etc. It will be seen that a reasonable chance of detection such as 0.9 or 0.8 corresponds to true differences in yields exceeding 10 per cent of the general mean yield and that the differences under 5 per cent will be left undetected very frequently, more than in 80 per cent of all cases.

Now the experimenter is able to judge whether the efficacy of the proposed trial is sufficient. If a gain in yield amounting to 5 per cent is considered negligible and if it is really essential to discover only such differences as 10 per cent or over, then he will judge that the experiment planned is satisfactory. If, however, the process of improving the varieties he is concerned with is already fairly advanced, so that



it is more or less hopeless to look for a gain in yield as large as 10 per cent, then probably he will make some efforts to assure a greater chance of detecting smaller differences, when they exist. This may be achieved in three ways, separately or in combinations.

(1) We may increase the number of replications of each variety and consequently also the number of degrees of freedom.

(2) We may use a less stringent level of significance, say  $\alpha=0.05$  instead of  $\alpha=0.01$  proposed previously. This will lead to an increase in the chance of error when stating that  $V_1$  does give better yields than the standard variety  $V_0$ , but it will also increase the chance of detecting the advantage of  $V_1$  when it exists. To illustrate this point we give the following Table B similar to Table A and describing the efficacy of the same experiment under the assumption that  $\alpha=0.05$ .

TABLE B. LEVEL OF SIGNIFICANCE  $\alpha=0.05$ 

Size of real differences in average yields in percentage of the average yield	12.54	10.38	9.24	7.86	6.84	4.38	3.54	2.52	1.14
Chance of non-detection	0.01	0.05	0.10	0.20	0.30	0.60	0.70	0.80	0.90

It is seen that applying a more liberal level of significance we shall have a reasonable chance of detecting a difference in yield such as 8 per cent and that the differences which will be overlooked in 80 cases out of 100 and over are those below 2.52 per cent of the general mean. Thus the detecting power of the experiment is considerably increased.

(3) The third and the most desirable way of increasing the efficacy of the experiment consists in lowering the standard error  $\sigma$  of any single plot yield, i.e. in improving the experimental technique.<sup>6</sup>

*Example IV.* Let us consider more closely the situation outlined in Example II. Suppose then that the buyer of some manufactured product insists on having evidence that the mean value  $a$  of some character  $X$  of individual units in a consignment exceeds a fixed limit  $a_0$ . We have seen already that such "evidence" could result from the inspection of a sample drawn from the consignment and from the test of an asymmetrical hypothesis,  $H_a$ , that  $a \leq a_0$ . If after having applied the test this hypothesis is rejected, then the buyer will accept the consignment. Errors in testing consignments are, of course, inevitable, but suppose that the buyer does not want to be wrong in accepting unsatisfactory consignments more often than with the relative frequency, say one in a hundred. This is easily achieved by fixing the level of significance  $\alpha=0.01$ . The choice of the proper level of significance entirely protects the interests of the buyer, and other details

<sup>6</sup> Some indications of how this may be achieved will be found in the joint paper of Neyman, Iwaskiewicz and Kolodziejczyk already referred to.

of the test of the consignments of goods are more or less indifferent for him. But now consider the problem from the point of view of the producer. It is obvious that the manufactured products may have in fact the average value of the character  $X$  well above the fixed limit  $a_0$  and then, through chance causes, the consignment may not pass the test, thus causing considerable financial loss. It is therefore in the interests of the producer to assure that the products he is delivering should have a reasonable chance of passing successfully the test.

Since the publication of the well known book of Shewhart<sup>7</sup> there will be scarcely any larger works which would not apply the modern methods of inspection. We may therefore assume that the manufacturer knows approximately the value of the standard deviation,  $\sigma_0$ , of the character  $X$  of single units in consignments he is delivering and also that he is able to direct the process of manufacturing so as to obtain consignments with the average value of this character having approximately any desired (and attainable) value  $a$ . We shall now show how he may use the Tables I and II in order to assure a reasonable chance for his goods to pass the test of the buyer.

Denote by  $n'$  the number of single units in the sample, which will be inspected, and by  $\bar{x}$  the mean of the character  $X$  which will be calculated for the sample. The standard error of  $\bar{x}$  will be equal to  $\sigma_{\bar{x}} = \sigma_0/\sqrt{n'}$  and may be assumed to be approximately known. The number of degrees of freedom on which the estimate of  $\sigma_{\bar{x}}$  will be based is  $n = n' - 1$ . Now the values of  $\rho$  for  $\alpha = 0.05$  and  $0.01$  come from Tables I and II; and the relation between  $\rho$  and the values of  $a_0$ ,  $a$ ,  $\sigma_0$  and  $n'$  is

$$(7) \quad \rho = (a - a_0)/\sigma_{\bar{x}} = (a - a_0)\sqrt{n'}/\sigma_0$$

from which

$$(8) \quad a = a_0 + \rho\sigma_0/\sqrt{n'}.$$

Substituting here for  $\rho$  the figures from the row corresponding to the  $n = n' - 1$  of Table II, we shall find what should be the true value of the average  $a$  so as to reduce the chance of an unjust rejection of the consignment to some specified level, say 0.01 or 0.05, etc.

Assume, for example, that  $a_0 = 100$ ,  $\sigma_0 = 10$  and that the proposed value of  $n'$  is  $n' = 16$ . Then  $n = n' - 1 = 15$  and if the producer desires that the chance of his goods passing successfully the test should be at least 0.95, he should aim at the average value of the character  $X$  equal to

$$(9) \quad a = 100 + 4.38(10/4) = 110.95.$$

If the true average value of  $X$  in his consignments is still exceeding

<sup>7</sup> W. A. Shewhart; *The Economic Control of Quality of Manufactured Product*. New York, 1931.

$a_0 = 100$  but is lower than the above limit, 110.95, the consignments will be rejected more frequently. For example, the frequency of unjust rejection equal to 0.5 will correspond to consignments in which the true average of  $X$  is equal to

$$(10) \quad a = 100 + 2.56(10/4) = 106.4.$$

According to circumstances, the effort of producing goods of an average quality exceeding the desired level by 11 per cent may be too costly and the producer may prefer to bear the costs of a more stringent test instead. It will be seen that if the sample to be tested is increased to contain say 64 individual units instead of 16, then the number of degrees of freedom will be 63 and in order to have the chance of 95 per cent of the consignment passing the test, the producer will have to aim at the average value of  $X$  in the consignments contained between the following limits say

$$(11) \quad a_1 = 100 + 4.16(10/8) > a > 100 + 3.97(10/8) = a_2$$

or

$$(12) \quad 105.20 > a > 104.97,$$

where the numbers  $a_1$  and  $a_2$  correspond to the numbers of degrees of freedom  $n=30$  and  $\infty$  respectively.

The examples considered above illustrate the simplest cases where the Tables I and II could give useful information. However, it will be recognized that the range of application of these tables is extremely broad. They will be particularly useful when discussing more or less complex experiments leading finally to statistical test of "Student's" hypothesis of asymmetrical type.<sup>8</sup> In many a case it will be found that a particular experiment would be useless because of the exceedingly small chance of detecting effects which are likely to be met with and which are of practical value.

Before concluding we must call attention to the fact that the tables assume normality in the populations sampled. However, excellent sampling experiments by E. S. Pearson showed that if the actual distributions show but moderate departures from normality, the effect of this is in many cases negligible.<sup>9</sup> Another point which seems to be worth while mentioning concerns the possibility of using the tables when the hypothesis tested is symmetrical. It will be easily seen that in that case the tables will be *approximately* valid too, except that instead of the levels of significance  $\alpha=0.05$  and  $\alpha=0.01$  they will correspond to  $\alpha=0.10$  and  $\alpha=0.02$  respectively. The approximation will be better for smaller values of  $P_{II}$  than for the larger ones.

<sup>8</sup> See, for example, *Supplement to the J.R.S.S.*, Vol. II, 1935, pp. 235-241.

<sup>9</sup> E. S. Pearson: "Statistical Methods in the Control and Standardisation of the Quality of Manufactured Products." *J.R.S.S.*, Vol. XCVI, Part I, 1933.

## THE STATISTICAL VIEW OF NATURE\*

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IT IS VERY gratifying for one who is neither a statistician nor a physicist to be asked to speak to you on statistical concepts and the physical world. I take it that you have chosen this topic because you feel that recent changes in the fundamental ideas of physics and especially Heisenberg's Indeterminacy Principle have some bearing on your work, and that you have invited a philosopher rather than a physicist or a statistician because you wish to consider not technical details but how the whole enterprise appears to one who stands outside of both physics and statistics and tries to observe the main currents in both. I shall therefore limit myself to a consideration of elementary ideas, in the belief that the rudiments need, and can stand, eternal repetition.

Since the beginning of modern statistical science, its leaders such as Quetelet have in agreement with the pioneers of the other social sciences insisted that progress is possible only if we introduce the rigorous and deterministic methods which have brought such great success to the physical sciences. And now we are witnessing physical science itself not only raising doubt as to the adequacy of Newtonian mechanics and the law of the conservation of energy, but also challenging the entire classical conception of physical causation. This has caused considerable disturbance in the social sciences; but certain philosophers, both positivists and those of theologic leaning, are rejoicing. For the latter have been asserting for some time that our knowledge of physics is statistical only, of the same kind as our knowledge of social phenomena when these are the result of large numbers.

To discuss the elements of this issue, I shall begin by considering the characteristics of statistical knowledge, and then try to analyze the nature of statistical mechanics and the significance of determinism in a statistical view of the world. I shall conclude with venturing some application as to the limitations of statistical measurement. Before doing so, it is interesting to note how many fundamental terms which the social sciences are trying to adopt from physics have as a matter of historical fact originated in the social field. Take, for instance, the notion of *cause*. The Greek *aitia* or the Latin *causa* was originally a

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purely legal term. It was taken over into physics, developed there, and in the 18th century brought back as a foreign-born king for the adoration of the social sciences. The same is true of the concept of *law of nature*. Originally a strictly anthropomorphic conception, it was gradually depersonalized or dehumanized in the natural sciences and then taken over by the social sciences in an effort to eliminate final causes or purposes from the study of human affairs. It is therefore not anomalous to find similar transformations in the history of such fundamental concepts of statistics as *average* and *probability*. The concept of *average* was developed in the Rhodian laws as to the distribution of losses in maritime risks. After astronomers began to use it in correcting their observations, it spread to other physical sciences; and the prestige which it thus acquired has given it vogue in the social field. The term *probability*, as its etymology indicates, originates in practical and legal considerations of probing and proving. And now we are trying to fit social phenomena into the patterns of probability worked out by mathematical physicists such as LaPlace and Poisson, and by mathematicians like Gauss and Karl Pearson.

What are the essential traits that differentiate statistical from other kinds of knowledge? It is usual to discriminate it from history on one hand and from mechanics on the other.<sup>1</sup> These distinctions are worth noting.

Historical knowledge is concerned with individual objects or events, with individual persons, nations, or institutions having a definite date or position in time. Statistical knowledge differs in this respect by being concerned with numerical relations in multitudes which are fungible, i.e. in which individual differences are ignored. To know that the population of the United States in 1800 was 4,000,000 is, to be sure, historical in so far as it describes the United States at that time and indicates its power relative to other nations, but it is statistical in respect to the individuals who constitute that population. It gives us no information about any one of them. And this ignorance is not cured by averaging. If I am told that the average family then consisted of 5.6 persons, I do not thereby learn anything about any actual family. We are not thus denying that statistical information is a necessary aid in the understanding of history. To determine what was the population of Athens in 430 B.C. or of the United States in 1790 is surely a most significant task of history; but we do not thereby attain direct

<sup>1</sup> The reader will note that the text distinguishes between different kinds of knowledge. The scientific statistician, of course, must use all the kinds of knowledge he can obtain, including pure mathematics which is certainly not in itself statistical.

information about any individual citizen, what were the peculiar traits that made some of them, like Pericles or Washington, such outstanding figures. This distinction between the historical and the statistical is also valid in the realm of physics. If I know that there was an earthquake or an eclipse of the moon or that a column of mercury attained a certain height on a given occasion, my knowledge is so far purely historical. And from a logical point of view our knowledge of the geologic changes which our earth has undergone is of the same logical pattern as our knowledge of the changes in the dynasties which have ruled Egypt. In both cases we reconstruct individual past events on the basis of observations of presently existing records or remains. On the other hand, our knowledge of physical nature is strictly statistical whenever it is concerned with averages such as heights or weights of groups of objects or with the relative frequencies with which certain phenomena occur.

The distinction between statistical and mechanical knowledge deserves even greater attention. The classical view held generally throughout the 18th and 19th centuries regarded the principles of Newtonian mechanics, like those of Euclidean geometry, as self-evident or in some way necessary. Thus, philosophers like Kant, Whewell, and Wundt have tried to derive the Newtonian laws of mechanics from entirely a priori considerations. Also, great physicists like J. J. Thomson, the successor of Maxwell, explicitly declared the laws of dynamics to be in some sense superior to those which like the second law of thermodynamics, are merely based on experience. But the general distrust of self-evident principles that has come with non-Euclidean geometry and the recent development of non-Newtonian mechanics makes this position a difficult one to maintain. All the ultimate laws of nature which we know are contingent, that is, we know of no reason why these laws should prevail in fact rather than others which are conceivable; and the really decisive evidence for the truth of the laws of any mechanical system is that their consequences are verifiable, that is, agree with experimental observations. Yet though mechanical laws of the classical type are not justified by their self-evidence and are not independent of experience, they can be clearly distinguished from statistical laws by the fact that they *assert universal or invariant connections in nature*. Whenever we have two particles, they attract each other with a force that varies inversely as the square of the distance between them; or, whenever a body moves freely under the influence of a constant force, the velocity acquired will be proportional to the time during which the force acts. A single exception can thus logically refute the law. Now, statistical laws or correlations do not take such

universal form, but assert rather certain frequencies, for example, that a little over 51 per cent of all births are male. This, however, does not enable us to predict individual instances. To say that 75 per cent of the Romans were tall, e.g., above 5' 5", gives us no warrant for inferring that Cato was tall. And to say that this information makes it probable that Cato was tall does not really determine the individual case, for he may well have been only 5' 4" despite the fact that so many of his fellow-countrymen were taller. This makes a tremendous difference in the problem of verification. A universal proposition asserts something to be impossible and if that which is thus excluded does take place our proposition is definitely refuted. It is thus always conceivable and sometimes actually the case that a single crucial experiment can refute an hypothesis or supposed law. And if another hypothesis is thus confirmed, the latter may be said to be verified in the sense that it has been shown to be in greater harmony with experimental observation than its rival or competing hypothesis. Thus, if the classical theory predicts an observable motion relative to the aether, and such motion does not show itself under proper conditions of observation in the Michelson-Morley experiment, we have definite evidence against the classical theory. And if the Einstein theory of relativity can explain this experiment as well as all that the classical theory does, we have definite reasons for preferring it. Statistical generalizations, however, cannot be so readily verified by any crucial experiment. Consider for instance, the well established statistical observation that as the number of voters increases, the pluralities in favor of some candidate increase also. According to this view, there is a negligible probability that the millions of voters of New York State will in the next election be exactly evenly divided between the Democratic and Republican candidates for Governor. If, however, that should actually happen, it will not refute our statistical generalization since the latter does not declare a tie vote under these conditions to be impossible.

It may well be objected that this sharp distinction between mechanical and statistical laws in regard to verification, overlooks the fact that statistical laws apply not to individual instances but only to large groups or over a long run, and that when so taken they are verifiable. Thus, consider the classical statistical law referred to before as to the ratio of male to female births. If, for a long period and over a wide area this ratio is not found to prevail, we should surely regard it as refuted by experience, and some other ratio might be verified. This objection, however, while perfectly true does not fully obviate the difficulty to which we have pointed. For the test as to when a run is sufficiently long to verify a statistical law cannot in the nature of the

case be very precise. A few repetitions of the Michelson-Morley experiment are necessary to make certain that we have not overlooked something. But they are repetitions of what is essentially the same experiment which if true is sufficient to overthrow the contradictory universal. But no one can well determine just how many reports of different cities for different years would be necessary to refute the statistical law referred to above.

I do not wish to ignore difficulties in pressing the foregoing point. The history of science undoubtedly shows that crucial experiments are very infrequent, and that they do not play the absolutely decisive role which popular histories of science ascribe to them. No single experiment overthrew the Ptolemaic astronomy. Galileo's supposed refutation of Aristotle's theory of gravitation by throwing two objects from the tower of Pisa is rather mythical, for it does not seem that under the actual conditions of height and atmospheric friction and the means of observation, this experiment could have been decisive. Despite Lavoisier's experiments, the phlogiston theory continued to be held for a long time. Nevertheless, the issues in each of these cases were definitely formulated because universal laws were involved and single facts, such as the observed phases of the planet Venus or the increased weight of certain substances after being burned, were definitely and directly contrary to the predictions. If a single fact is not generally sufficient to overthrow completely a supposed universal law which it contradicts, it is because an established hypothesis generally rests not on a single chain of arguments but on many interwoven threads, so that the cutting of one of these threads is not at once fatal. Moreover, theories are flexible and can be reformulated, or have auxiliary hypotheses added, e.g., Lavoisier's experiments can be explained by endowing phlogiston with negative weight. But in any case every single theoretic statement in regard to nature takes the form of universal propositions which can be definitely refuted by a single contradictory instance and this is not true of statistical statements.

Another way of stating the distinction between mechanical and statistical laws is that the former state causal relations while the latter are mere correlations. It is not necessary to go into the traditional discussions as to the nature of causality. It is sufficient for our present purpose to insist that a causal relation means some intimate connection or thread of identity between two things, traits or events thus connected, while a statistical correlation may mean nothing more than a temporary coincidence. The fallacious assumption that a high correlation must necessarily represent a causal relation, while not held by scientific statisticians, is still widely current. In a book of mine published



a few years ago, I referred to Dr. George Marshall who found a correlation of 87 per cent between the membership of the International (really American) Machinists' Union and the death rate of the state of Hyderabad. Many of my readers have since protested vigorously that such a high correlation extending over twelve years cannot be accidental or devoid of real significance. But the fact is that the correlation does not hold beyond the period taken. Indeed, it obviously could not have prevailed before the Machinists' Union was formed when there was still a considerable death rate in that Hindu State. If more instances of this sort are not available it is because most of us have no interest in such purely logical demonstrations. We look for correlations where we suspect a real connection and then we regard whatever small correlation we find as a proof of our hypothesis. Where there are genuine causal connections we should expect statistical correlation, but the converse is not necessarily true. Genuine physical and mechanical laws are thus more than statistical correlations. The law of the conservation of energy and Newton's law of motion, are all empirical in the sense that they depend for their verification on observation, but they also indicate some element of identity in cause and effect, or antecedent and consequent, and that is more than mere statistical correlation. The observation that a certain correlation prevails for a certain period does not of itself give us reason for supposing that it prevailed before we observed it or that it will do so in the future. But scientific procedure in physics cannot go on without assuming that the relations we deal with prevailed before we discovered them and are independent of our knowing them. Careful statisticians recognize this when they draw a distinction between gross and refined statistics, between birth rates where the denominator is the total population and those based on the number of married women of child-bearing age. Such distinctions are based on the recognition that causal relations are necessary to give statistical correlations real significance.

The foregoing reflections suggest one of the reasons why there is in fact much less consensus in regard to social than physical laws as statements of invariant or causal relations. If we formulate a theory of business cycles or of the variations of the stock market, and the actual facts do not conform, we do not generally abandon the theory, but we explain the departure of the facts by means of disturbing factors that prevent a fair test of our assumed law. Now, the existence of perturbations is also found in physics. But in the latter the effect of disturbing forces can generally be measured independently. That, however, is generally impossible when as in the case of the weather or of biologic and social phenomena generally, we have a large number

of factors that are not independent of each other. Hence, in dealing with such complex phenomena we can seldom prove that if a given disturbing factor were absent, our assumed law would operate. To attain invariant relations we must be able to isolate our factors or vary one at a time. Otherwise, we have too many variables and no assumption of ours can be definitely verified. The analysis of any situation into its related factors is therefore the condition for any definite test as to the truth of even statistical generalizations.

It is important to remember that we do not always get nearer to the truth by increasing the number of cases on which our generalization is based. Observations on fifty Chinese laundrymen no more justify the generalization as to Chinese in general than an observation of twenty Chinese, if they all come from Canton, all belong to the same society, etc. It is only when by good fortune the randomness of our samples does eliminate the fallacy of selection that a larger number gives better evidence than a smaller number. In the end, the truth of a generalization from a sample depends on the homogeneity of the group with respect to which we wish to generalize. A single experiment on a new substance, to test whether it is acid or alkaline, is much more convincing than the result of a questionnaire addressed to millions of army men to measure their intelligence. For the latter is not a simple quality of a uniformly repeatable pattern. In this respect, the methods of social statistics are gross compared with the refinements of analysis, so that when our analysis is thoroughgoing, as it generally is in physics, one or two samples are as good as million. If what we are measuring is really homogeneous, one instance is sufficient. In the social field, therefore, too, statistics cannot take the place of analysis; and in fact acute social analysts have contributed much more to our understanding of social phenomena than those who, without genius or vision, have believed that the mere collection of instances will give us adequate knowledge.

Statistical method has been closely associated with the belief in what is loosely called induction, and it is often asserted that the founders of statistical science were men who, like Sir William Petty and those who organized the Royal Society, were influenced by Francis Bacon. It would take me far afield to show the mythical character of this history. A few observations, however, are essential. There can be no doubt that statistics deals with actuality, and that knowledge of actualities is always empirical, i.e., that we cannot obtain knowledge of existence by purely a priori methods. There is, however, no genuine progress in scientific insight through the Baconian method of accumulating empirical facts without hypotheses or anticipation of

nature. Without some guiding idea we do not know what facts to gather. Without something to prove, we cannot determine what is relevant and what is irrelevant. If we wish to find the laws of the weather, the thousands of millions of observations will not of themselves indicate the true causes of laws. Only when we strike some fruitful idea or hypothesis such as the late Carl Barus did in determining the influence of dust on the concentration of moisture, can we make some progress in the understanding of nature. Economic statistics, charts of the variations of prices, incomes, imports and exports, etc., do not constitute science unless organized, controlled and informed by some general idea. A collection of data will not give us science any more than a collection of ores will give us metal works. We need fire to fuse our material into some pattern. In science we achieve that, if we discover the proper perspective from which the order of phenomena becomes visible to the trained eye. This does not mean that we do not often go wrong because of false hypotheses, but it is well to recall the caution of a great naturalist, viz., Charles Darwin, who rightly maintained that the danger of false hypotheses is never as great as that of a false observation. For even a false hypothesis may enable us to advance the organization of our material; but everything that is based on a false observation has to be undone before we can build anew on more reliable data. But note that even in statistical work we do not dispense with a priori assumptions, that is, with assumptions which are based on general considerations and which cannot be readily refuted by empirical considerations. We can see this in our various assumptions as to what are independent or equiprobable events. I do not wish to touch on the subject of probability which will be more adequately treated by Dr. Nagel. But I must call attention to the fact that in all statistical measurement and inference we do involve ourselves in assumption as to what events are equally probable and what events are independent. And in this field priori considerations are most potent. Ask people at large, what is the probability of a penny falling head? Almost everybody answers one-half, although few have ever taken an actual count of the relative frequency with which pennies fall head or tail. The answer comes in fact not on the basis of actual observation, but on the indetermination which prevents us from giving heads a preference over tails. If, however, we ask whether Americans are as likely to pay their bills as Germans, we do not ask for data, nor are we likely to say that one is as likely as the other. The answer will largely depend on where we live. Our belief, then, in the probability of an event is largely determined by considerations other than statistical study. And this, curiously enough, has misled many trained

scientists. Thus the astronomer Proctor insists that if a penny has been thrown up fifty times and has fallen head forty times, the probability of the next throw being head is still one-half. Those who say this, however, are confusing mathematical reasoning (to wit: what follows if we make a certain assumption) with an existential assertion. If the probability of a penny falling head as often as tail were built on experience alone, any long run of tails or of heads ought to throw doubt on our assumption of independence and equiprobability. It is absurd to suppose what is established on the basis of past observation cannot be upset or modified by increased observation.

We must, therefore, reject the tradition of which Quetelet and Buckle were the high priests, and which spoke of statistical averages as if they were iron and unchangeable laws of nature beyond human control. (People still speak of the average or the mean about which our numbers oscillate as the normal man with some implication perhaps that the normal is the perfect.) Obviously there is no law of nature which compels the normal family to have 2.7 children or the normal man to divorce his wife or commit bankruptcy once in so many years. There is, therefore, also no merit in the argument that the existence of such averages proves that human volition cannot change what these averages describe. Statistical averages do give us knowledge of groups if there are in fact laws which keep the distribution in those groups approximately stable. But that empirical generalizations do not always give us genuine laws can be seen in popular generalizations about diet, exercise, the evil eye, lucky and unlucky numbers, the length of cycles on the stock market, etc. Are such generalizations more reliable if expressed in numbers, charts or curves?

As a matter of fact we know of no statistical laws comparable in constancy with the law of multiple proportion in chemistry or of planetary motion in astronomy. All the social statistical averages that we know vary somewhat, as Lexis and others have shown, from year to year and are conditioned by our social and political regulations. Many of them, e.g., the number of bank failures per annum, car loadings or automobile accidents, have no meaning except under special conditions which come and pass, while mechanical laws are independent of geography and chronology. For the very meaning of causality is that mere position in time or place cannot in itself determine a natural change.

Suppose that in the social field you find a formula like Pareto's that fits the tables of incomes for several countries for a number of years. Does it follow that it is a law which will persist and which legislation cannot change? Some have actually argued to that effect, but in point

of fact it is not true universally, and does not hold for small incomes.<sup>2</sup>

Statistical information needs refined analysis before it can lead to causal or rigorously scientific information. If we know that the average life of men is less than that of women we ask, is it due to occupation, habits, or to organic handicaps? We need to pass from the macroscopic to the microscopic point of view.

It is necessary to insist on these obvious reflections because of the widespread manner of speaking of the law of large numbers and the normal frequency curve as if they were a priori laws of nature governing the distribution of all possible phenomena. This popular view is logically groundless and vitiates much statistical work such as that involved in much of our intelligence testing.

Let us remember that the curve of distribution derived from the Gaussian assumptions can hold true only where these assumptions happen to be true in fact. Now, the curve assumes that our phenomena or instances are symmetrically distributed, but this is obviously not true of all phenomena even if their number is indefinitely increased. Many anthropologic measurements certainly do not conform to it, e.g., the death rate, the acceleration and retardation of growth in children, and the like. In many cases to be sure, larger groups show greater stability and more balance or symmetry than the smaller groups which constitute them, but the reverse is also true at times. The normal probability curve is a help in analysis, but as a description of nature it is true only of those groups of figures which happen to conform to it. There is no fair presumption that all groups will conform.

## II

So far I have been considering the distinction between statistical laws or correlations on one hand and mechanical laws on the other. But we have with us the science of statistical mechanics. What light does it throw on our issue? Let us consider it in three stages: first, the classical form of statistical mechanics; second, the modification introduced by the quantum theory; and third, the more recent wave mechanics and the Indeterminacy Principle.

The conception of a statistical knowledge of nature was first clearly enunciated by Maxwell (though partly anticipated by Calusius) in connection with the law of entropy. In his day it was assumed that all genuine physical laws must be deducible from Newtonian mechanics. But the irreversibility of certain physical changes, e.g., the diffusion of gases or the fact that heat is conducted only from hotter to colder

<sup>2</sup> The difference between an empirical and a rational formula can be seen when we compare the carpenters' rule for constructing a right angle with the Pythagorean theorem. The carpenters' rule holds only for lengths of 3, 4, and 5, while the Pythagorean theorem gives us a whole system of geometric propositions or an infinite series of such possible numbers.

bodies, could not be deduced from mechanical principles concerning phenomena that are essentially reversible. This led Maxwell and Boltzmann to the idea that this irreversibility is not a fundamental law of nature holding like the laws of Newtonian mechanics always and everywhere from the largest mass to the smallest particle, but that it is a derivative result from the arrangement of molecular motions according to the curve of "error" or probability. From this point of view it is by no means impossible, though highly improbable, that some phenomena may actually take place contrary to the law of entropy. There have indeed been those who have urged that organic phenomena and even Brownian movements illustrate this possibility. It should be noted, however, that this classical system of so-called statistical mechanics does not proceed from empirical observations, by averaging and establishing correlations. Rather does it begin by assuming that there are definite laws which determine the distribution of molecular velocities in accordance with the Gaussian function originally derived to describe the distribution of errors of observation. This law of distribution is thus assumed to be an invariant law of nature, though it does not enable us to determine the position of any particular molecule. It is well to note also that statistical mechanics is still mechanics. It continues to assume the Hamiltonian principle, and still proceeds from a theoretically assumed system of mechanical laws in the microscopic realm to explain observable macroscopic phenomena. No wonder, therefore, that Maxwell could talk of statistical mechanics and yet believe in the absolute uniformity of all molecules, fresh as they issued from the hand of the Creator.

At the end of the 19th century, its leading physicist, the venerable Lord Kelvin, spoke of two clouds in the mechanical view of the universe, its difficulties in explaining the Michelson-Morley experiment and the partition of energy in the spectrum. Both of these difficulties proved insurmountable and led to revolutionary changes. The first difficulty led to the non-Newtonian mechanics of Einstein's relativity theory. The second difficulty led to the perhaps more radical departure from classical mechanics, the quantum theory of Planck and Einstein. The classical theory regarded the Universe as made up ultimately of separate particles, and yet the radiation of energy was regarded as continuous—a view which Einstein has well characterized as maintaining that the world is both soup and a bag of hard peas. Now, the actual distribution of energy in the spectrum cannot be fitted into the theory that energy radiation is continuous, and this seems to eliminate the continuity of the world which is the essence of the classical geometric view which goes back through Newton, Galileo and Kepler to the early

Greek geometers. The world consists not only of individual particles but also of multitudes of quanta of energy. This strengthens the statistical view so far as the latter proceeds by summation. The quantum theory, however, not only retains mechanical or invariant laws, such as are embodied in Hamilton's Principle, but adds new ones, to wit, exclusion principles such as Pauli's, which assert that certain states are impossible in nature.

After a series of great achievements, the quantum theory began to encounter insurmountable difficulties and a seemingly more revolutionary form of mechanics—popularly known as wave mechanics—began to take possession of the field.

From the popular viewpoint, the most impressive novelty of this mechanics is Heisenberg's Indeterminacy Principle, according to which all physical measurements are subject to an indetermination within one quantum. We have always known empirically that our measurements vary and that laws or universal propositions about the physical universe can never be absolutely verified in actual measurements. Heisenberg's Principle, however, goes farther and gives us a theoretic basis in the very nature of our mechanical laws for assigning a definite limit beyond which greater accuracy is unattainable. This in itself does not necessarily mean a denial of the principle of causality or an assertion of indeterminism in the objective physical world. It may be explained as a consequence of the fact that any measurement which involves observation of nature through light is itself a physical operation which disturbs the object observed. But be that as it may, the radical feature of the new mechanics is that its basic law or equation does not assert an invariant rule that determines the position and velocity of every individual particle, but asserts rather a probability function so that with regard to any electron or photon it can tell us only the relative frequency with which it will be found in a given position. Though called the wave mechanics, the new physics really abandons the effort at a precise picture or mechanical model of what goes on in the microscopic realm that forms the physical sub-stratum of the visible world. It thus seems to abandon at the outset the possibility of an absolutely accurate and exhaustive description of the world. The indeterminacy which it introduces into physics is the indeterminacy of passing from an average or a probability function to an individual instance. For a law which describes how a group of individuals are distributed does not give us precise knowledge of any individual constituent of the group. In this sense, the new mechanics is more conscious of the old truth that our most accurate knowledge of the physical world is never free from an element of probability. While this involves

profound technical transformations in physical science it is not very revolutionary from the philosophic point of view. The new mechanics still operates with mathematical or invariant laws which relate one state of the physical system to past or future states. If any observable or macroscopic state of nature is determined, other states become determined. And that is after all the essence of the old mechanics. It was never necessary for physical science to assume that the classical mechanics completely exhausted the nature of things. The geometrical points and lines, the regular spheres, the perfectly rigid bodies of the classical mechanics were generally recognized as limiting concepts which represented, to be sure, features of the actual world but never exhaustive accounts. The new mechanics recognizes this limitation explicitly. It uses a wider conception of "coordinates" or the elements which determine a "state" of nature. Just as a number may be resolved in different ways as the products of two factors, or just as a force acting in any direction may be resolved into different pairs of components, so states of nature according to the new physics can be regarded as resolvable into different "superposed" states without altering the physical consequences. The invariant relations of mechanics bind features of the visible macroscopic states together, and in that respect the classic tradition of mechanics still holds the field, even though we no longer hold the faith in very *simple* laws governing all things from the greatest to the smallest.

### III

Our brief glimpse of statistical mechanics reinforces the point that while statistical knowledge is distinct from mechanics it depends upon the latter as well as on history. There is no doubt that we can sometimes make progress in science by ignoring the question of mechanics and studying variations statistically. This has notably been the case with the Darwinian doctrine of natural selection. Neither Darwin nor Mendel went into the causes of variation. Still Mendel, trained as a physicist, made possible the great advance in genetics by seeking and finding an invariant rate. There is no reason to suppose that if variations were completely lawless, the resultant of a large number of them would show any order or recognizable pattern. If any group shows conformity to the law of large numbers, it means that its individual variations are governed by certain forces which bring about symmetry, decreasing frequencies of larger variations, and all the other features which have to be assumed in order to justify a frequency curve. This brings us to the main issue.

The statistician used to be taught to have faith in determinism.



Shall he now follow popularizers of recent physics and regard it more scientific and up-to-date to profess indeterminism? It is tempting to say that he need take neither position, that all he needs to assume is that the universe has certain observable statistical regularities. What, however, does the latter statement imply? Admitting for example, that we do not know the cause or causes which disintegrate any particular atom of uranium, and that all we do know are observable regularities in the behavior of the macroscopically visible masses, the fact remains that we cannot get along in science or in practice without expecting such regularities to recur. What ground have we for this expectation? The answer is that if we assume that our visible material is composed of an unimaginably large, but still calculable, number of invisible microscopic elements and that there are invariant laws according to which the happenings in this realm may be distributed and integrated, we have the most powerful means at our command for the discovery and understanding of an ever increasing number of physical phenomena. We may therefore regard our assumption as well established or verified as any other bit of reliable knowledge in our possession. If the most reliable social statistics, such as our mortality rates for different years, do not exhibit such measurable stability, it is not merely due to the smaller numbers in the latter field, but also to the fact that we here deal with more factors that are not isolable, so that the invariant relations between them are not so readily ascertained. Hence more stable uniformities in the social realms are to be found not only by increasing the number of observations, but also by greater refinement of analysis. And this is exactly what a life insurance company does when instead of relying merely on an ever larger number of death records, it takes advantage of medical research as to the *causes* which prolong or shorten life. Its business would be even more secure if it could determine the true causes of war and rebellion as well as earthquakes and plagues. Without causal laws for the recurrence of phenomena, all our observations would at best belong only to the field of history and not to natural science. We should put down in our books that these frequencies were observed at such and such times; but we shall have no reason for expecting them to recur unless we believed such recurrence to be grounded in the nature of things.

A world of which statistical knowledge is possible is then a world in which there are variations which are in part individually unforeseeable and unpredictable, and therefore, inexplicable, but in which certain laws or regularities prevail. And if some one were to maintain as Poincaré once suggested, that the laws of nature are themselves changing then we should look for the law according to which such change

takes place. A body changes its position according to some law which may be expressed as a constant velocity. So changes in velocity involve either a constant acceleration or one that changes according to some law of force. Ultimately all change involves some constancy. This is not an empirical observation merely, but a condition of significant discourse. We cannot talk sense except on condition that our expressions have some definite meaning and there is no meaning without some element of constancy in the field of variation, wherever that is chosen.

We may see the same truth in a more specifically statistical context. Traditional statistical procedure has always assumed that the variations in our measurements of such magnitudes as the height of a mountain or the specific gravity of iron, are not variations of the object itself which is supposed to be constant, but are rather due to changes in our manipulations of the instruments of measurement. Now, suppose one questions this assumption, as Charles Peirce did long before the rise of the Indeterminacy Principle in physics. That highly original American philosopher ventured to suggest that behind the variations which fall within the limits of the error of measurement there are still smaller variations of the object itself, so that absolute constancy is an ideal never attained in actuality. As a philosophic suggestion this is worthy of more attention than we can devote to it here. For our present purpose it is sufficient to note that so long as the *variation can be expressed in some laws*, we have sufficient determinism for a statistical universe.

The recognition of the view that constancy and variation are polar categories, opposed but inseparable, each meaningless apart from the other, enables us to deal more clearly with the vexed problem as to chance and determinism, neither of which can be eliminated from a statistical view of nature. It is popular to say that chance merely expresses our ignorance. But this offers no basis for mathematical computation. Measurable chance is something that certainly does not depend on *individual* ignorance. When I ask today what chance is there of my dying on a Tuesday, there is to be sure an element of ignorance involved; but that is the ignorance which is necessarily involved in any system of finite knowledge. Nothing that anyone can find out by medical research or otherwise will be sufficient to determine completely or absolutely the individual event—not even the fact that I am condemned by a court of law to be hanged on that day. But on the assumption that the day of the week makes no difference, that as many people die on Tuesdays as on any other day of the week, and that we have to die on one or other of these, the chance of its happening on a Tuesday is one-seventh. The ignorance involved here is not absolute. We do

know something about the causes of death which enables us not only to be certain that death is coming, but that all pretensions that Tuesday is a lucky day or an unlucky one rest on insufficient evidence. If, on the other hand, it is a fact that people generally rest on Sunday or use their automobiles more, this may affect the relative death rates on the different days of the week. We may then say that a chance event dealt with in statistics is one for which we have determining principles that are necessary but insufficient. Pure chance is, indeed, incomprehensible unless defined with reference to some rule determining all possible variations. Thus, if we speak of the chances of a certain die turning up a six in three successive throws, we assume a limited number of possibilities all equally probable. If the chances were not regulated by some rule or order we should have no basis for any one result rather than any other. If there is any reason for any expectation, it is because there is some determination in the case, even though we do not know enough of what determines the individual event.

Similarly, reflection on the abstract character of the repeatable patterns which are the subject of statistical as well as of mechanical laws, enables us to see that law is meaningless apart from all contingency or chance.

It is a great mistake to believe that mechanical science involves a completely determined world, such as the Hegelian Absolute. On the contrary, if there are repeatable patterns or laws, there must be genuine plurality and this necessarily means relative independence or indifference. Thus, if everything depended on everything else, there would be no sense in saying that the photo-electric effect depends on the frequency of the impinging light, and not on other factors. Chance and determination are thus both objective logical consequences of the fact that any system with which science can deal must be defined and limited. Consider, for instance, the laws of celestial mechanics which make our solar system determinate. That some powerful body shall pass it so near as to cause it all to be smashed, would be an accident in the sense that from the coordinates of our system and the laws of celestial mechanics, the event cannot be determined. We can of course insist that if we knew the distance between our solar system and that body, and knew the rates at which they approach each other, we could predict the solar catastrophe. But this only means that we have to enlarge our original system to explain an event which would be an accident within the narrower domain. If, then, we distinguish between relativity and subjectivity, accidents are relative to the system and not to mere subjective opinions.<sup>3</sup>

<sup>3</sup> Professor Ducasse's strictures (page 347) ignore this relativity. The determinism of an absolutely complete universe is not an attainable,—certainly not a verifiable—factor in any natural science.

The question, however, may be raised, Are there any isolated systems? Are not all things inter-connected? In reply, we must insist that any intelligible system with which science can deal must be defined by a limited number of laws and determination thus limited. If you look at the world geometrically, certain features are connected with other features in certain invariant relations. If a disk, for instance, is circular or triangular, we compute its area according to certain invariant consequences of its geometric properties. That, however, which is necessary to determine an object geometrically will not be sufficient mechanically. So likewise, the masses and motion of a system may not determine all of its physical properties, and the latter may not be sufficient to specify the properties of an organism. Similarly, biologic factors alone may not be sufficient to determine how a man will vote or respond to a given argument. In general, sciences aim to attain the form of logical systems in which a limited number of laws determine all the processes and connections between the variables in the field. The propositions of any science thus form what a mathematician calls a group. To the extent that a number of propositions can be derived from a certain number of assumptions, they are so far independent of the truth or falsity of other propositions.

The foregoing considerations do not deny that as science grows, we learn more about the determination of things. We can see this in the way science finds univocal relations to take the place of less determinate or one-to-many relations. Consider a case of what is called a plurality of causes. If I think of headaches as a single species, I may find the causes in eye-strain, in noxious smoke, in improper food, in the degeneration of certain tissues or other factor. This may be sufficiently determinate for practical purposes. However, for scientific purposes I may analyze the different kinds of headaches and find that the one due to eye-strain is different from the one due to alcoholic drink. Or again, I may find that in all these different forms of headaches, there is one common factor, let us say a certain pressure on certain nerve endings. In the end, however, the determinism aimed at in any science is abstract. While events in nature are individualized, and every moment is different from every other, mechanical science and statistics are concerned with the fungible aspects of things, with those features which repeat themselves indefinitely. William James somewhere refers to an animal that is being experimented upon and referred to as a specimen, saying if it could, "Excuse me, it's me." We may stretch this and say that if the individual molecule could speak, it would say, "To be sure, I am a member of the noble species of hydrogen molecules, but I am altogether different from some of my degenerate neighbors." Physics may recognize different *kinds* of hydrogen atoms,

just as vital statistics may distinguish between male and female deaths. It is to history and to intimate human relations that individual differences are of the utmost importance. The individual is more than any of its phases, and there would be no determination if there were not something to be determined. If, therefore, there is such a thing as genuine individuality, if the world consists of a number of things which are genuinely distinct from each other, although they modify each other in certain abstract ways, then there is a genuine incommensurability between the individual and the universal. Each is an unattainable limit to the other. No number of rules then can exhaustively determine the fullness of individual existence, though every change of abstract or isolated phase may be invariably connected with corresponding changes in other beings. Statistics and mechanics cannot therefore dispense with history.

## IV

The foregoing reflections are not without bearing on the problem of measurement by statistical methods in the social sciences.

In the first place, we ought not to overlook the obvious distinction between enumeration and measurement. We can enumerate a multitude, but the measurement of a continuous quantity or magnitude involves other operations. Thus we measure length by laying off a standard unit. We measure weight by a process of balancing, and of course the measurement of all derivative magnitudes involves more complicated processes. The full meaning of measurement in the physical sciences is seen when that which is measured is an extensive quantity to which the addition theorem is applicable. Those traits of nature which are not subject to these conditions are not, strictly speaking, measurable. Briefly, the modern analysis of measurement calls attention to the following conditions: (1) we must be able to identify a standard character or state capable of indefinite repetition, (2) we must define some operation to determine when two magnitudes are equal, and (3) we must define some operation which will give meaning to the sum of two or more magnitudes. It may be urged that in the measurement of intensive magnitudes, the last of these conditions is absent. The fact, however, is that in the measurement of physical intensities such as temperature and the like, we always try to connect that which is measured with extensive elements such as distances on a thermometer scale, and this is very difficult to achieve in the social realm. Even if we limit ourselves to intensive social magnitudes such as pleasures or preferences, we find that statistics do not give us very much information, for our human preferences are proverbially inconsistent or

highly variable in time according to incalculable subjective factors. We may put it in other terms by saying that in measuring human attitudes by questionnaires or records of preferences, we are dealing with the resultants of so many factors that the empirical results are seldom highly significant. For, as we saw before, where we do not isolate a single determinant we cannot expect to find a determinate relation. Somewhat similar warnings have been made in biology and in physics; and social phenomena are even more complicated because they include not only physical and biologic elements, but also such factors as fashion, linguistic attitudes and the like. It becomes evident, then, that mere accumulation of social statistics will not enable us to isolate the relevant factors and to determine constant relations any more than we have been able to do with meteorologic statistics. Where we deal with fungible goods as we do in the realm of economics, we ignore all but the factor defined, such as price, amount of supply, etc. But how strong a desire for economic gain will outweigh tabus against forbidden food, working on the Sabbath, making graven images, or doing something which is dishonorable or results in loss of caste, we are hardly in a position to tell by statistical methods alone. Certainly the questionnaire method with children in the movies or students in the class room, selected because they can be readily induced to take the trouble to answer, can hardly claim to be adequate measurement. There is little evidence that the replies of other people will be the same as that of our selected group, and there is no way in which we can be assured that we have not fallen into the fallacy of selection no matter how much care we have exercised to choose at random. There are always characteristics of our group which we do not have in mind or reject as irrelevant but which may in fact be the most important factors in determining the results—for instance, our particular neighborhood, social class, temporary fashion or response to some special condition of the experiment which we have no thought of as significant. Thus, some one examines a number of school children in a given city and compares the standing of Jews and non-Jews. But the Jews happen to be of a special neighborhood where the parents follow certain occupations or all come from Turkey or Saloniki, and are as different from Russian or German Jews as Turks are from Russians and Germans.

Another confusion in the attempt to use statistics in social measurement is the failure to discriminate between a phenomenon and people's opinion about it. Suppose you wish to measure that illusive quality, intellectual eminence. A leading psychologist who is entitled to our profound respect because of his many achievements, tries to dispose of the issue by asking a number of specialists to make an estimate and

then treating their answers statistically. But is not this measuring rather a group of opinions? The belief that the average of a number of judgments by experts is necessarily more correct than the judgment of any one of them is based on the assumption that all these judgments are independent. But is that assumption always true? Experts in a given field read the same books or periodicals and are subject to vogues or fashions. When a vote is taken as to who is the leading psychologist, ablest baseball player, most beautiful actress or most interesting novel, the results may be more indicative of something about the voters for the time being than about that which is voted.

The whole scheme of intelligence-testing assumes something whose nature is very ill-defined. Indeed, some of the leaders in this field first took the trouble to prove that there is no such thing as general intelligence and then proceeded to devise methods for measuring it. We must have clear ideas as to what it is that we are measuring.

There are other and subtler fallacies resulting from too great reliance on the technical procedures of statistical methods. Consider, for instance, some of the conclusions as to heredity by Galton and Karl Pearson. If we ignore the statistical methods and look at the matter critically, we can see that the extent of their material does not justify their conclusions. Surely a study of a thousand cases for two or three generations cannot determine the laws of inheritance, as to what traits are and what traits are not constant in environmental changes. I do not wish to deny that improved statistical methods enable us to guard against such errors. But it is elementary logic rather than technical statistics that enables us to realize this. I may in passing express the suspicion that biometric methods in genetics may by emphasizing unit characters, be doing violence to the fact that in an organism various elements are not completely independent, and that statistical methods based on the assumption of such independence lead us astray.

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## DISCUSSION

1. In Professor Cohen's paper occurs the statement that "accidents are relative to the system and not to our subjective opinions." This means that an accident in a given system is that which cannot be predicted in terms of the laws of that system and the state of the system at a given time. It seems to me, however, that "a given system" means only such a portion of the universe as we choose to consider; and that the fact that accidents do occur in a system we consider shows that, objectively, it is not properly called a system, but is only a part of the total system of the universe, and connected with its other parts. The accidentality of accidents is thus wholly relative to subjective selection by us of a *part only* of the universe.

2. Professor Cohen objects to the statement that "chance merely expresses our ignorance" on the ground that, e.g., the chance of my dying on a Tuesday can be calculated, and ignorance is not a basis for calculation.

Is it not the fact, however, that the word "chance" is currently used in two distinct, though related, ways? In the expression "the chance of my dying on a Tuesday," chance means *probability*, and that probability is calculated on the basis of what we *now do know* about the day of the week on which my death will occur, viz. that it is one out of only seven.

In an expression such as: "whether so and so will occur is a matter of chance," a matter of chance means a matter *unpredictable* because we *do not know* what would be needed to predict it. Thus, the word chance is used sometimes to refer to the fact that we *know* enough to tell something (though not everything) that we should like to be able to tell about the occurrence of an event; and sometimes to refer to the fact that we *do not know* enough to tell anything that we should like to be able to tell about the occurrence of an event.

3. Professor Cohen stated that, with the growth of our knowledge, "events which are undetermined now, will become determined later." This seems to me to overlook the difference between determinism and predictability. Predictability requires not only that events be determined, i.e., be according to some law, but in addition that we should (1) know what that law is, and (2) know what now is the state of the system within which that law holds. Growth of knowledge, thus, may render the now unpredictable later predictable, but not the now undetermined later determined.

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## EVALUATING THE EFFECT OF INADEQUATELY MEASURED VARIABLES IN PARTIAL CORRELATION ANALYSIS

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PARTIAL and multiple correlation are used, ordinarily, in the absence of a theory as to the mathematical relationship among the variables. A simple linear combination is assumed and the principal attention is focused either on the regression equation as a predictive tool, on one of the partial correlation coefficients, or on a comparison of the so-called "relative importance" of the different independent variables.

It is not generally recognized that such an analysis assumes that each of the variables is perfectly measured, such that a second measure  $X'$ , of the variable measured by  $X$ , has a correlation of unity with  $X$ . If some of the measures are more accurate than others, the analysis is impaired. For example, the sociologist may have a problem in which an index of economic status and an index of nativity are independent variables. What is the effect, if the index of economic status is much less satisfactory than the index of nativity? Ordinarily, the effect will be to underestimate the significance of the less adequately measured variable and to overestimate the significance of the more adequately measured variable.

A variable may be "inadequately" measured in either or both of at least two respects: (1) The measure may have low reliability, that is, it fails to measure *something* consistently. For example, a score derived from the odd-numbered questions on a test of social attitudes may have a low correlation with the parallel score derived from the even-numbered questions on the same test. Or, the schedules in a standards-of-living study may be so badly filled out that the correlation between indexes derived from similar schedules filled out by two different interviewers of the same families may be low. (2) The measure may have high reliability, yet low validity. That is, it fails to measure adequately what it purports to measure. A reliable test may not necessarily be a valid test of social attitudes, as might be checked by correlating the test scores with some other index of social attitudes. Or, indexes derived from accurately filled out schedules in a standards-of-living study may have a low correlation with indexes from schedules based on a

different, though equally defensible, concept of standards of living.<sup>1</sup>

If either the reliability or validity of an index is in question, at least two measures of the variable are required to permit an evaluation. The purpose of this paper is to provide a logical basis and a simple arithmetical procedure (a) for measuring the effect of the use of two indexes, each of one or more variables, in partial and multiple correlation analysis and (b) for estimating the likely effect if two indexes, not available, could be secured.

#### THEORETICAL CONSIDERATIONS

Let us assume that we have  $s$  variables, of each of which there exist two measures  $X$  and  $X'$ , based on  $n$  cases. Our problem is to compare the results from the use of both  $X_i$  and  $X'_i$  with the results from the use of  $X_i$  alone. The problem might be examined still more generally by considering  $k$  measures of each variable  $X_i$ . The present paper, however, is limited to a consideration of the two measures  $X_i$  and  $X'_i$ , of each of our  $s$  variables.

The writer has considered three different approaches, which, though different in their initial logic, lead, as will be proved, to identical results in important special cases.

(1) If we consider  $X_1$ , the dependent variable, satisfactorily measured, such that  $X'_1$  may be disregarded, we may find the multiple correlation of  $X_1$  with  $X_2$  and  $X'_2$  holding constant the remaining  $2(s-2)$  variables. The theory was described by the writer in a previous paper in this JOURNAL.<sup>2</sup> Expressing  $v_1$ ,  $v_2$ , and  $v'_2$  as respective deviations from the planes

$$v_1 = X_1 - (a_1 + b_{13.3'4...ss'}X_3 + b_{13'.34...ss'}X'_3 + \dots + b_{1s'.33'...(s-1)'s}X'_s)$$

$$v_2 = X_2 - (a_2 + b_{23.3'4...ss'}X_3 + b_{23'.34...ss'}X'_3 + \dots + b_{2s'.33'...(s-1)'s}X'_s)$$

$$v'_2 = X'_2 - (a'_2 + b_{2'3.3'4...ss'}X_3 + b_{2'3'.34...ss'}X'_3 + \dots + b_{2's'.33'...(s-1)'s}X'_s)$$

one finds the multiple correlation between the values of  $v$ . This correlation coefficient, since it has properties both of multiple and of partial correlation, has been called  $r_{1.22'.33'...ss'}$ , the coefficient of combined partial correlation, and it has been shown that it may be expressed in terms of conventional values of  $r$  by writing

$$r_{1.22'.33'...ss'} = \sqrt{1 - (1 - r_{12.33'...ss'}^2)(1 - r_{12'.233'...ss'}^2)}. \quad (1)$$

<sup>1</sup> Another type of inadequacy may arise when  $X_i$  and  $X'_i$ , say, are ratios with a common inaccurate denominator  $p$ , while  $X_j$  does not contain  $p$ . Then  $r_{ij}$  under certain conditions will be too high. (Cf. Karl Pearson, *Proceedings of the Royal Society*, lx, 1897, p. 489.) If  $r_{ij}$  is too high,  $r_{i..}$  ordinarily will be overestimated as compared with  $r_{i..}$ . However, this so-called "spurious correlation" is negligible in cases where it is logical to use percentages or ratios in social or demographic statistics, as G. Udny Yule has shown (*Journal of the Royal Statistical Society*, lxxiii, 1910, p. 644). The writer's present considerations do not deal with the problem discussed by Pearson and Yule and should not be confused with it.

<sup>2</sup> "A Coefficient of 'Combined Partial Correlation' with an Example from Sociological Data," this JOURNAL, v. 29, March, 1934, pp. 70-71.

This approach to our problem has two limitations, among others. It does not provide for two measures of the dependent variable and it requires  $(2s-1)$  dimensions for handling a problem with only  $s$  sets of measures. On the other hand, if one has a problem with only three sets of measures this method provides a useful procedure for comparing  $r_{1.22'.33'}$  with  $r_{1.33'.22'}$  and noting how they differ from  $r_{12.3}$  and  $r_{13.2}$ , respectively. Equation 1 may be written

$$r_{1.22'.33'} = \sqrt{\frac{r_{12.33'}^2 + r_{12'.33'}^2 - 2r_{12.33'}r_{12'.33'}r_{22'.33'}}{1 - r_{22'.33'}^2}}. \quad (1a)$$

If  $r_{12} = r_{12'}$ , and  $r_{23} = r_{2'3} = r_{23'} = r_{2'3'}$ , while  $r_{22'}$  and  $r_{33'}$  are each  $\neq \pm 1$ , Equation 1a reduces to a simple form in terms of zero-order  $r$ 's, namely,

$$r_{1.22'.33'} = \frac{r_{12}d_{33} - r_{13}r_{23}}{\sqrt{(d_{33} - r_{23}^2)(d_{22}d_{33} - r_{23}^2)}}, \quad (1b)$$

where  $d_{ii} = \frac{1}{2}(1 + r_{ii})$ . If we possess only one index of the variable measured by  $X_3$ , Equation 1a reduces to

$$r_{1.22'.3} = \sqrt{\frac{r_{12.3}^2 + r_{12'.3}^2 - 2r_{12.3}r_{12'.3}r_{22'.3}}{1 - r_{22'.3}^2}}, \quad (1c)$$

which, if  $r_{12} = r_{12'}$ , and  $r_{23} = r_{2'3}$ , while  $r_{22'} \neq \pm 1$ , reduces to the very convenient form

$$r_{1.22'.3} = \lambda r_{12.3}, \quad (1d)$$

where  $\lambda = \sqrt{(1 - r_{23}^2)/(d_{22} - r_{23}^2)}$  and  $d_{22} = \frac{1}{2}(1 + r_{22'})$ . It is evident from an inspection of the expression under the radical that  $r_{1.22'.3} > r_{12.3}$ , as would follow from the property of  $r_{1.22'.3}$  as a multiple correlation coefficient. The value of  $r_{1.22'.3}$  may be compared with the conventional value of  $r_{13.22'}$  and it can then be noted how they differ from  $r_{12.3}$  and  $r_{13.2}$ , respectively.

(2) Let us now avail ourselves of  $X_1$  and  $X'_1$ , two measures of the dependent variable, and join a fourth equation to the three considered above, namely,

$$v'_1 = X'_1 - (a'_1 + b_{1'.3.4'...s'}X_3 + b_{1'.3.4'...s'}X'_3 + \dots + b_{1'.s'.33'...(s-1)'s}X'_s).$$

Write  $y_i = v_i/\sigma_{v_i}$  and form the sums  $(y_1 + y'_1)$  and  $(y_2 + y'_2)$ . Since  $\sigma_{v_i} = 1$ , whence

$$\sigma_{y_i + y'_i} = \sqrt{\sigma_{v_i}^2 + 2r_{v_i v'_i} \sigma_{v_i} \sigma_{v'_i} + \sigma_{v'_i}^2} = \sqrt{2(1 + r_{v_i v'_i})}$$

and since  $\Sigma y_i y'_i / n = r_{v_i v'_i}$ , we have

$$r_{(y_1 + y'_1)(y_2 + y'_2)} = \frac{\Sigma (y_1 + y'_1)(y_2 + y'_2)}{n \sigma_{y_1 + y'_1} \sigma_{y_2 + y'_2}} = \frac{r_{y_1 y_2} + r_{y_1 y'_2} + r_{y'_1 y_2} + r_{y'_1 y'_2}}{2\sqrt{(1 + r_{y_1 y'_1})(1 + r_{y_2 y'_2})}}$$

whence, from the relation  $r_{y_i y_j} = r_{i j . 33' \dots ss'}$ ,

$$r_{(y_1+y'_1)(y_2+y'_2)} = \frac{r_{12.33' \dots ss'} + r_{12'.33' \dots ss'} + r_{1'2.33' \dots ss'} + r_{1'2'.33' \dots ss'}}{2\sqrt{(1 + r_{11'.33' \dots ss'})(1 + r_{22'.33' \dots ss'})}}. \quad (2)$$

It is interesting to consider again the case of three variables. Equation 2 reduces to

$$r_{(y_1+y'_1)(y_2+y'_2)} = \frac{r_{12.33'} + r_{12'.33'} + r_{1'2.33'} + r_{1'2'.33'}}{2\sqrt{(1 + r_{11'.33'})(1 + r_{22'.33'})}}. \quad (2a)$$

If we now assume that  $r_{ij} = r_{ij'} = r_{i'j} = r_{i'j'}$ , while  $r_{ii'} \neq 1$ , Equation 2a may be shown to reduce to

$$r_{(y_1+y'_1)(y_2+y'_2)} = \frac{r_{12}d_{33} - r_{13}r_{23}}{\sqrt{(d_{11}d_{33} - r_{13}^2)(d_{22}d_{33} - r_{23}^2)}} \quad (2b)$$

where  $d_{ii} = \frac{1}{2}(1 + r_{ii'})$ . If we use only one index of the independent variable, Equation 2b reduces to a form identical with (1b). Moreover, if we use only one index each of  $X_1$  and  $X_3$ , Equation 2b reduces to

$$r_{y_1(y_2+y'_2)} = \lambda r_{12.3}, \quad (2c)$$

which is identical with (1d).

It will be observed that, although  $(y_1+y'_1)$  and  $(y_2+y'_2)$  are index numbers formed by combining two measures of each factor, it is not necessary arithmetically to go through the process described, since Equation 2 expresses our results directly in terms of correlation coefficients between the original measures of  $X$ . The principal limitation of this approach seems to be the fact that it requires  $2s$  dimensions to handle a problem involving only  $s$  pairs of measures.

(3) By our third approach we reduce the problem to  $s$  dimensions. Writing  $z_i = (X_i - \bar{X}_i)/\sigma_i$ , where  $\bar{X} = \Sigma X_i/n$ , we form the sums

$$\begin{aligned} t_1 &= z_1 + z'_1 \\ t_2 &= z_2 + z'_2 \\ &\dots \dots \dots \\ t_s &= z_s + z'_s \end{aligned}$$

and seek to express the relationships among the values of  $t$  in terms of relationships among the original values of  $X$ .

Remembering that  $\sigma_{ii} = 1$ , whence  $\sigma_{ii} = \sqrt{2(1 + r_{ii'})}$ , and that  $\Sigma z_i z_j/n = r_{ij}$ , where  $r_{ij}$  is the zero-order correlation between  $X_i$  and  $X_j$ , we have

$$\begin{aligned} r_{i_i t_j} &= \frac{\Sigma(z_i + z'_i)(z_j + z'_j)}{2n\sqrt{(1 + r_{ii'})(1 + r_{jj'})}} \\ &\quad \frac{r_{ij} + r_{ii'} + r_{ij'} + r_{i'j'}}{4\sqrt{[(1 + r_{ii'})/2][(1 + r_{jj'})/2]}} \quad \bar{r}_{ij} \quad \sqrt{d_{ii}d_{jj}} \end{aligned} \quad (3)$$

where  $\bar{r}_{ij} = \frac{1}{2}(r_{ij} + r_{ji})$ , the average zero-order intercorrelations, and where  $d_{ii} = \frac{1}{2}(1 + r_{ii})$ .

Consider now the conventional correlation matrix

$$\begin{array}{ccccccc} 1 & r_{i_1 i_2} & \cdots & r_{i_1 i_s} & & & \\ r_{i_1 i_2} & 1 & \cdots & r_{i_2 i_s} & & & \\ \cdot & \cdot & \cdots & \cdot & \cdots & \cdots & \\ r_{i_1 i_s} & r_{i_2 i_s} & \cdots & 1 & & & \end{array} \quad (3a)$$

which, upon substitution of the values of  $r_{i_i i_j}$  found in (3), becomes

$$\begin{array}{ccc} 1 & \frac{\bar{r}_{12}}{\sqrt{d_{11}d_{12}}} & \frac{\bar{r}_{1s}}{\sqrt{d_{11}d_{1s}}} \\ \frac{\bar{r}_{12}}{\sqrt{d_{11}d_{22}}} & 1 & \frac{\bar{r}_{2s}}{\sqrt{d_{22}d_{1s}}} \\ \vdots & \vdots & \vdots \end{array} \quad (3b)$$

$$\frac{\bar{r}_{1s}}{\sqrt{d_{11}d_{1s}}} \quad \frac{\bar{r}_{2s}}{\sqrt{d_{22}d_{1s}}} \quad \cdots \quad 1$$

Multiply the elements in the first row by  $\sqrt{d_{11}}$ , the elements in the second row by  $\sqrt{d_{22}}$ , etc. Multiply the elements in the first column by  $\sqrt{d_{11}}$ , the elements in the second column by  $\sqrt{d_{22}}$ , etc. We have

$$\frac{1}{d_{11}d_{22} \cdots d_{ss}} \begin{vmatrix} d_{11} & \bar{r}_{12} & \cdots & \bar{r}_{1s} \\ \bar{r}_{12} & d_{22} & \cdots & \bar{r}_{2s} \\ \cdot & \cdot & \cdots & \cdot \\ \bar{r}_{1s} & \bar{r}_{2s} & \cdots & d_{ss} \end{vmatrix} \quad (3c)$$

and we write

$$\Delta' = d_{11}d_{22} \cdots d_{ss}$$

As a consequence of the operation in passing from (3b) to (3c), any  $(s-1)$ -rowed minor of  $\Delta'$ ,

$$\Delta'_{ij} = \frac{\sqrt{d_{ii}d_{jj}}}{d_{11}d_{22} \cdots d_{ss}} \Delta_{ij}, \quad (3d)$$

where  $\Delta'_{ij}$  is formed by crossing out the  $i$ 'th row and  $j$ 'th column in  $\Delta'$ . This is a special case, where  $m_i = 2$ , of a more general determinant in which  $d_{ii} = [1 + (m_i - 1)\bar{r}_{ii}]/m_i$ , in which  $\bar{r}_{ii}$  is the average of the  $m_i(m_i - 1)/2$  intercorrelations between  $m_i$  measures of a given varia-

ble  $i$ . It is of interest to note that as  $m_i \rightarrow \infty$ ,  $d_{ii} \rightarrow \bar{r}_{ii}$ , whence, if  $m_j$  also  $\rightarrow \infty$ ,  $\bar{r}_{ij}/\sqrt{d_{ii}d_{jj}} \rightarrow \bar{r}_{ij}/\sqrt{\bar{r}_{ii}\bar{r}_{jj}}$ , which is a form of the correlation coefficient corrected for attenuation.<sup>3</sup>

Solution of this determinant gives the equations needed, in terms of zero-order correlation coefficients, for the complete analysis of our problem. Equation 3c makes explicit the assumption, as to the intrinsic accuracy of all variables, which is implicit in the conventional partial correlation analysis. Only as every value  $r_{ii'} \rightarrow 1$ , whence  $d_{ii} = \frac{1}{2}(1+r_{ii'}) \rightarrow 1$ , and as every value  $\bar{r}_{ij} \rightarrow r_{ij}$ , does  $\Delta'$  approach the usual form. In other words, the customary correlation analysis assumes that every  $X_i$  would correlate perfectly with another measure  $X'_{i'}$ , of the same variable.

Let us now consider three variables only, namely,  $t_1$ ,  $t_2$ , and  $t_3$ . Equation 3c becomes

$$\begin{array}{ccccc} d_{11} & \bar{r}_{12} & \bar{r}_{13} & & \\ & \bar{r}_{12} & d_{22} & \bar{r}_{23} & \\ d_{11}d_{22}d_{33} & & & & \\ & \bar{r}_{13} & \bar{r}_{23} & d_{33} & \end{array} \quad (3e)$$

The four types of values in which there is likely to be most interest with respect to our present problem are  $r_{t_1t_2..t_3}$ ,  $\beta_{t_1t_2..t_3}$ ,  $\beta_{t_1t_2..t_3}r_{t_1t_2}$ , and  $R^2_{t_1..t_2t_3}$ . In the interest of clarity, the notation will be changed by writing  $(i+i')$  in the place of  $t_i$  in the subscripts. Let us now express our desired measures in terms of the zero-order correlations between the original values of  $X_1$ ,  $X_2$ , and  $X_3$ , remembering that  $\bar{r}_{ij} = \frac{1}{2}(r_{ij} + r_{ij'})$ , and that  $d_{ii} = \frac{1}{2}(1 + r_{ii'})$ .

(a) When there are two measures each of  $X_1$ ,  $X_2$ , and  $X_3$ .

$$\begin{aligned} r_{(1+1')(2+2')(3+3')} &= \frac{\Delta_{12}}{\sqrt{\Delta_{22}\Delta_{11}}} = \frac{\Delta'_{12}}{\sqrt{\Delta'_{22}\Delta'_{11}}}, \quad \text{from (3d),} \\ &\quad \frac{\bar{r}_{12}d_{33} - \bar{r}_{13}\bar{r}_{23}}{\sqrt{(d_{11}d_{33} - \bar{r}_{13}^2)(d_{22}d_{33} - \bar{r}_{23}^2)}} \end{aligned} \quad (3f)$$

It will be observed that if we write  $r_{ij} = \bar{r}_{ij}$ , (3f) becomes identical with (2b); otherwise, (3f) may be expected to differ from (2) because of the different logic behind the respective derivations.

$$\begin{aligned} \beta_{(1+1')(2+2')(3+3')} &= \frac{\Delta_{12}}{\Delta_{11}}, \quad \text{from (3d),} \\ \frac{\Delta'_{12}}{\Delta'_{11}} \sqrt{\frac{d_{22}}{d_{11}}} &= \left( \frac{\bar{r}_{12}d_{33} - \bar{r}_{13}\bar{r}_{23}}{d_{23}d_{33} - \bar{r}_{23}^2} \right) \sqrt{\frac{d_{22}}{d_{11}}}. \end{aligned} \quad (3g)$$

<sup>3</sup> For the general proof see the writer's paper, "Reliability Coefficients in a Correlation Matrix," *Psychometrika*, June, 1936. Equation 3 can be shown to be a special case of Equation 147 in Truman L. Kelley, *Statistical Methods*, p. 197.

$$\beta_{(1+1)(2+2)(3+3)} r_{(1+1)(2+2)} = \left[ \frac{\bar{r}_{12}d_{33} - \bar{r}_{13}\bar{r}_{23}}{d_{11}(d_{22}d_{33} - \bar{r}_{23}^2)} \right] \bar{r}_{12}. \quad (3h)$$

$$R^1_{(1+1)(2+2)(3+3)} = 1 - \frac{\Delta}{\Delta_{11}} = 1 - \frac{\Delta'}{\Delta'_{11}d_{11}} \quad (3i)$$

$$= \frac{\bar{r}_{12}^2d_{33} + \bar{r}_{13}^2d_{22} - 2\bar{r}_{12}\bar{r}_{13}\bar{r}_{23}}{d_{11}(d_{22}d_{33} - \bar{r}_{23}^2)}.$$

(b) When there are two measures each of  $X_1$ , and  $X_2$ , and when there is one measure of  $X_3$ . Substitute  $d_{33}=1$  in Equation 3e or Equations 3f to 3i, inclusive. Example:

$$r_{(1+1)(2+2).3} = \frac{\bar{r}_{12} - \bar{r}_{13}\bar{r}_{23}}{\sqrt{(d_{11} - \bar{r}_{13}^2)(d_{11}d_{22} - \bar{r}_{23}^2)}}. \quad (3j)$$

If we write  $r_{ij}=\bar{r}_{ij}$ , (3j) becomes identical with results obtained from reducing (2b).

(c) When there is one measure of  $X_1$  and when there are two measures each of  $X_2$  and  $X_3$ . Substitute  $d_{11}=1$  in (3e) or Equations 3f to 3i, inclusive. Example:

$$r_{1(2+2).(3+3)} = \frac{\bar{r}_{12}d_{33} - \bar{r}_{13}\bar{r}_{23}}{\sqrt{(d_{33} - \bar{r}_{13}^2)(d_{22}d_{33} - \bar{r}_{23}^2)}}. \quad (3k)$$

If we write  $r_{ij}=\bar{r}_{ij}$ , Equation 3k becomes identical with (1b), or with (2b) when  $d_{11}=1$ . The three approaches to our problem coincide in results at this point, although, if  $r_{ij} \neq \bar{r}_{ij}$ , we may expect differences.

(d) When there is one measure each of  $X_1$ , and  $X_3$ , while there are two measures of  $X_2$ . Substitute  $d_{11}=d_{33}=1$  in Equation 3e or Equations 3f to 3i, inclusive. Write  $r_{13}=\bar{r}_{13}$ . Examples:

$$r_{1(2+2).3} = \frac{\bar{r}_{12} - \bar{r}_{13}\bar{r}_{23}}{\sqrt{(1 - r_{13}^2)(d_{22} - \bar{r}_{23}^2)}}, \quad (3l)$$

which, if  $r_{12}=\bar{r}_{12}$ , and if  $r_{23}=\bar{r}_{23}$ , reduces, exactly as (1b) and (2b) reduce, to

$$r_{1(2+2).3} = \lambda r_{12.3}, \quad (3m)$$

where  $\lambda = \sqrt{(1 - r_{13}^2)/(d_{22} - r_{23}^2)}$ , an identity with (1d) or (2c). Moreover,

$$r_{12.(2+2)} = \frac{r_{13}d_{22} - \bar{r}_{13}\bar{r}_{23}}{\sqrt{(1 - r_{13}^2)(d_{22} - \bar{r}_{23}^2)}}. \quad (3n)$$

If  $r_{12} = r_{12'}$  and if  $r_{23} = r_{2'3}$ , we may write (3n) as

$$r_{13.(2+2)} = \frac{r_{13}d_{22} - r_{12}r_{23}}{\sqrt{(1 - r_{12}^2)(d_{22} - r_{23}^2)}}, \quad (3o)$$

which can be shown to be identical with the conventional formula for  $r_{13.22'}$  under the same assumptions, where  $r_{13.22'}$  is the partial correlation coefficient between  $X_1$  and  $X_3$ , with  $X_2$  and  $X'_2$  held constant. When  $r_{12} = r_{12'}$  and  $r_{23} = r_{2'3}$  and when  $r_{12.3}$ ,  $r_{13.2}$ ,  $r_{1(2+2).3}$ , and  $r_{12.(2+2)}$  each  $\neq 0$ , we write

$$\frac{r_{1(2+2).3}}{r_{13.(2+2)}} = k \frac{r_{12.3}}{r_{13.2}}, \quad \text{whence}$$

$$\frac{\lambda r_{13.2}}{r_{13.(2+2)}} = \frac{r_{13} - r_{12}r_{23}}{r_{13}d_{22} - r_{12}r_{23}} > 1,$$

if  $r_{13}$  is positive and  $> r_{12}r_{23}$ , or if  $r_{13}$  is negative and  $< r_{12}r_{23}$ .

If  $r_{12} \neq r_{12'}$  and if  $r_{23} \neq r_{2'3}$ , the logic of our derivation would require that  $r_{1(2+2).3}$  be compared with  $r_{13.(2+2)}$ , rather than with  $r_{13.22'}$ . It will be observed that the arithmetical operations needed to calculate (3n) are simpler than those needed to calculate  $r_{13.22'}$ .

By similar methods the reader may find easily the values of  $r_{(1+1).23}$  or of any other functions derived from the correlation matrix.

We have seen that when  $r_{ij} = r_{i'j'} = r_{ij'} = r_{i'j}$ , our second and third theoretical approaches lead to identical values of partial  $r$ , and that when  $r_{11'} = 1$ , where  $X_1$  is the dependent variable, our first approach also coincides in results. It is the writer's judgment that the third approach is to be preferred, both theoretically and practically, because of its simplicity and generality. It reduces a problem with  $2s$  sets of measures to one of  $s$  dimensions. It permits a ready comparison not only of such values as  $r_{1(2+2).3}$  and  $r_{13.(2+2)}$ , or some functions thereof, but also of such values as  $\beta_{1(2+2).3}$  and  $\beta_{13.(2+2)}$ , or the products of the Betas with  $r_{1(2+2)}$  and  $r_{13}$ , respectively, or of such a value as  $R^2_{1.(2+2).3}$ . It avoids logical difficulties as to dependent and independent variables which might possibly appear from the application of least square theory in the second approach, and it permits the computation of standard errors by conventional formulas. Each of the three approaches assumes  $X_i$  and  $X'_i$  to be of equal weight or value for use in an index.

The third approach, it will be remembered, assumes that an index number  $t_i$  is formed by finding  $z_i = (X_i - \bar{X}_i)/\sigma_i$  and  $z'_i = (X'_i - \bar{X}'_i)/\sigma'_i$  and adding these two standard measures. It is possible, especially if  $X$  is a fraction and  $X'$  is another measure of  $(1 - X)$ , that  $X$  and  $X'$  will be negatively correlated. Naturally, in combining  $X$  and  $X'$  in an



index, a research worker would reverse the signs either of  $z$  or  $z'$ , making the correlation positive. This is not strictly required in the theoretical development above; except that if  $r_{ij'}$  is negative the problem becomes indeterminate when  $r_{ij'} = -1$ . Arithmetically, of course, it is not necessary to compute the index number  $t_i$ , as Equations 3f to 3i, inclusive, or any other measures derived from Equation 3c, may be computed directly from the correlation coefficients involving the original measures of  $X$  and  $X'$ , taken individually. If  $r_{ij'}$  is negative, one should change the sign of  $r_{ij'}$  to positive and reverse the signs in all other correlation coefficients involving  $X'$ .

Finally, it often happens that one has some reason to believe that a particular index is inadequate, yet has no second measure at hand. Nevertheless, he would like to know roughly how much difference it might make in his final interpretation if some second index could have been used. If he is willing to assume that the correlations of his unknown second index with the other variables would be the same as the correlations of his known first index with these variables, he can set an upper and lower limit of discrepancy by arbitrarily assigning to the unknown  $r_{ij'}$  a low value and then a high value. In the special case where Equation 3m is applicable, no computation is required, as values of  $\lambda$  in (3m) are presented in Table I for selected values of  $r_{22'}$  and  $r_{32}$ , or, rather, more generally for selected values of  $r_{jj'}$  and  $r_{jk}$ . It should be said with emphasis, however, that values derived by making these assumptions never should be reported *in lieu* of  $r_{12.3}$  or  $r_{13.2}$ . The new

TABLE I  
VALUES OF  $\lambda = \sqrt{(1-r_{ij'h}^2)/(d_{jj}-r_{jk}^2)}$  FOR USE IN THE EQUATION  $r_{i(j+\cdot).h} = \lambda r_{ij.h}$   
[Assuming that  $r_{ij} = r_{ij'}$ , and that  $r_{jk} = r_{j'k}$ , and writing  $d_{jj} = \frac{1}{2}(1+r_{jj'})$ ]

$r_{jk}$	$r_{jj'} = +.50$	$r_{jj'} = +.60$	$r_{jj'} = +.70$	$r_{jj'} = +.80$	$r_{jj'} = +.90$
.00	1.155	1.118	1.085	1.054	1.026
.05	1.155	1.118	1.085	1.054	1.026
.10	1.157	1.119	1.086	1.055	1.026
.15	1.159	1.121	1.087	1.055	1.027
.20	1.163	1.124	1.089	1.057	1.027
.25	1.168	1.127	1.091	1.058	1.028
.30	1.174	1.132	1.094	1.060	1.029
.35	1.183	1.138	1.098	1.062	1.030
.40	1.193	1.146	1.103	1.065	1.031
.45	1.207	1.155	1.110	1.069	1.033
.50	—	1.168	1.118	1.074	1.035
.55	—	1.184	1.129	1.080	1.038
.60	—	—	1.143	1.089	1.042
.65	—	—	1.162	1.100	1.046
.70	—	—	—	1.115	1.053
.75	—	—	—	1.139	1.063
.80	—	—	—	—	1.078
.85	—	—	—	—	1.104

$(r_{i(j+\cdot).h} = \lambda r_{ij.h})$  is Equation 3m in this paper.

values are supplements to the information obtained from  $r_{12.3}$  and  $r_{13.2}$ , not substitutes, and may be used cautiously as guides only. The same caution, of course, does not apply to the use of the more general results when all of the zero-order correlations are known, although in any case, the limitation must be kept in mind that  $X_i$  and  $X'_i$  are receiving equal weights.

#### ILLUSTRATIONS OF THE APPLICATION

(1) Suppose that we are interested in the question, "Why do residents of some areas of a large city move their abodes less often than residents of other areas?" We should guess that stability of residence must be closely related to home ownership. We also should guess that stability may be related to the presence of larger than average families who have a good many young children.

Using 1934 data for 651 Chicago census tracts,<sup>4</sup> we have three indexes:

$X_1$  = percentage of families residing at their present abode at least five years prior to the 1934 census.

$X_2$  = percentage of families with four or more members.

$X_3$  = percentage of families owning their own homes.

We take  $X_1$  as an index of stability in an area,  $X_2$  as an index of larger than average families, and  $X_3$  as an index of home ownership. Finding  $r_{12} = .6475$ ,  $r_{13} = .8501$ , and  $r_{23} = .6055$ , we obtain  $r_{12.3} = .317$  and  $r_{13.2} = .755$ .

Unfortunately, our index of larger than average families is unsatisfactory, because it fails to measure adequately the variable in which we are really interested, namely, the presence of larger than average families who have a good many young children. That is, we are questioning the validity of the index when it is to be used as an index of what we want to measure, because it fails to discriminate between families which may be composed wholly of adults and families which are composed partly of small children. It happens that we know the ratio of children under 5 to women 20 to 44 in each tract. Let us call this ratio  $X'_2$  and introduce it as a fourth variable in a conventional correlation analysis. Since  $r_{12'} = .5158$ ,  $r_{22'} = .6646$ , and  $r_{2'3} = .4283$ , we have  $r_{12.2'3} = .175$ ,  $r_{12'.23} = .179$ , and  $r_{13.22'} = .758$ . Evidently, both of our family indexes now almost vanish as compared with our index of home ownership. But a moment's reflection will indicate that in the present case  $r_{12.2'3}$  and  $r_{12'.23}$  have little, if any, realistic meaning.

<sup>4</sup> The data, including the zero-order correlation coefficients, were generously supplied by Richard O. Lang, fellow in sociology at the University of Chicago. The writer also is indebted to Mr. Lang for assistance in computation, especially in the preparation of Table I.

What we are really interested in is the combined association of  $X_2$  and  $X'_2$  with  $X_1$ , as compared with the association of  $X_2$  with  $X_1$ .

We decide to form a new family index,  $t_2 = z_2 + z'_2$ , where  $z_2 = (X_2 - \bar{X}_2)/\sigma_2$  and  $z'_2 = (X'_2 - \bar{X}'_2)/\sigma'_2$ . The computation of this index would be laborious, however, as there are 651 tracts. We can save the labor and get identical results by simply using our observed zero-order correlation coefficients in Equation 3l of the present paper. The computation takes practically no more time than that leading to first-order partials and, of course, much less time than that leading to second-order partials such as those in the preceding paragraph. We find that  $r_{1(2+2).3}$ , the correlation between the index of stability and the new and more inclusive family index, holding constant the index of home ownership, is .396, by Equation 3l, while  $r_{13.(2+2)}$ , the correlation between stability and home ownership, holding constant the new family index, is .776, by Equation 3n. We see that  $r_{1(2+2).3}$  is about twenty per cent larger than  $r_{12.3}$ , while  $r_{13.(2+2)}$  (which, in most problems, would be smaller than  $r_{13.2}$ ) is only two per cent larger than  $r_{13.2}$ .

We have been assuming that our index of stability and our index of home ownership are satisfactory. We recall, however, from a study using 1930 census tract data in Cleveland, Ohio<sup>5</sup> that a correlation of only .85 was found between  $X_3$ , the percentage of families owning their own homes and  $X'_3$ , the percentage of homes owned per 100 dwellings. A reason for the discrepancy is that if an area contains only two-family dwellings, the maximum home ownership by our index could be only 50 per cent, or if an area contains only four-family dwellings the maximum home ownership could be only 25 per cent. For our Chicago series no values of  $X'_3$  have been computed, though they might be obtained if necessary. In the Cleveland study, p. 217, we see that  $X_3$  and  $X'_3$  correlated about alike with several other social and economic variables, none of which, however, correspond to our  $X_1$ ,  $X_2$ , or  $X'_2$ . Assuming that the correlations of  $X'_3$  with  $X_1$ ,  $X_2$ , and  $X'_2$  would be about the same as the respective correlations of  $X_3$  with these variables, and assuming that for Chicago  $r_{33'}$  would be .90 at the minimum, because we have observed that  $r_{13} = .85$ , we can estimate what our results might have been if  $X'_3$  had been combined with  $X_3$  in a new index of home ownership. Little additional computation is required. Setting  $d_{11} = 1$ ,  $d_{22} = \frac{1}{2}(1 + r_{22'}) = .8323$ ,  $d_{33} = \frac{1}{2}(1 + r_{33'}) = .95$ ,  $r_{12} = \frac{1}{2}(r_{12} + r_{12'}) = .58165$ ,  $r_{13} = .8501$ , and  $r_{23} = \frac{1}{2}(r_{23} + r_{23'}) = .5169$ , we we substitute in Equation 3k of the present paper, obtaining

<sup>5</sup> Henry D. Sheldon, Jr., "Problems in the Statistical Study of Juvenile Delinquency," *Metron*, xii, December, 1934, pp. 201-23.

$r_{1(2+3) \cdot (3+3)} = .328$ , while  $r_{1(3+3) \cdot (2+2)} = .800$  is obtained after interchanging transcripts 2 and 3 in the same formula. Thus, the inclusion of a second index of home ownership, provided our assumptions hold, may lower  $r_{1(2+2) \cdot 3}$  about 17 per cent and raise  $r_{13 \cdot (3+2)}$  about 3 per cent. On the basis of this information, we can decide whether or not it is worth while to work up the actual data for  $X'_3$  and bring  $X'_3$  into the problem formally. We might, indeed, decide to neglect both  $X'_2$  and  $X'_3$ , since our last result is closer to the original than the second. But we now have information to guide us in our decision.

For comparative purposes, the values discussed, together with some additional values which may be of interest, are recorded below. (Incidentally, the independent computation of the square of the multiple correlation coefficient by two different formulas may be used, as in the conventional correlation analysis, as an automatic check on the arithmetic used in calculating the partial  $r$ 's and  $\beta$ 's.)

$r_{12 \cdot 3} = .317$	$r_{1(2+2) \cdot 3} = .396$	$r_{1(2+2) \cdot (3+3)} = .328$ , estimated.
$r_{13 \cdot 2} = .755$	$r_{13 \cdot (2+2)} = .776$	$r_{1(3+3) \cdot (2+2)} = .800$ , estimated.
$\beta_{12 \cdot 3} r_{12} = .136$	$\beta_{1(2+2) \cdot 3} r_{1(2+2)} = .166$	$\beta_{1(2+2) \cdot (3+3)} r_{1(2+2)} = .126$ , estimated.
$\beta_{13 \cdot 2} r_{13} = .615$	$\beta_{13 \cdot (2+2)} r_{13} = .612$	$\beta_{1(3+3) \cdot (2+2)} r_{1(3+3)} = .661$ , estimated.
$R^2_{1 \cdot 23} = .751$	$R^2_{1 \cdot (2+2)3} = .778$	$R^2_{1 \cdot (2+2)(3+3)} = .787$ , estimated.

(2) Let us suppose that in the foregoing problem we had reason to feel satisfied with  $X_1$  and  $X_2$ . Our information from the Cleveland study leads us to wonder how much our values of  $r_{12 \cdot 3}$  and  $r_{13 \cdot 2}$  would be altered if we improved the index  $X_3$  by combining with it  $X'_3$ . Assuming that  $r_{13'}$  would equal  $r_{13}$  and that  $r_{23'}$  would equal  $r_{23}$ , and writing  $r_{33'} = .90$  on the same grounds as in the second paragraph preceding, we have, from Equation 3m,

$$r_{1(3+3) \cdot 2} = \lambda r_{13 \cdot 2}$$

where  $\lambda$  may be found without computation, simply by entering our Table I, with  $r_{jk} = r_{32} = .85$  and  $r_{jj'} = r_{33'} = .90$ . We see that  $\lambda = 1.104$ , and therefore estimate  $r_{1(3+3) \cdot 2} = 1.104 \times .755 = .83$ . To estimate  $r_{12 \cdot (3+3)}$  on the same assumptions, we need only to substitute our observed  $r_{12}$ ,  $r_{13}$ , and  $r_{23}$  and our guessed value of  $d_{33} = \frac{1}{2}(1 + r_{33'}) = .95$  in Equation 3o (after an interchange of transcripts in 3o), obtaining  $r_{12 \cdot (3+3)} = .28$ , which is about 10 per cent less than  $r_{12 \cdot 3} = .317$ .

(3) Returning again to the Cleveland study, we use a different set of data. We seek the relationship between  $X_1$ , the juvenile delinquency rate in 1928-31 by census tracts,  $X_2$ , an index of dependency in 1928,

and  $X_3$ , the percentage of native whites in the population. Given  $r_{12} = .75$ ,  $r_{13} = -.51$ , and  $r_{23} = .60$ , from p. 206, we have  $r_{12.3} = .65$ . After the study is completed, a parallel index for 1931 becomes available. Call it  $X'_2$ . Shall we include it in the study? Assume that we have no knowledge of  $r_{12'}$ ,  $r_{22'}$ , and  $r_{2'3}$ . Since  $r_{12} = .75$ , we are probably justified in assuming that  $r_{22'}$  is at least .80. While the dependency rate in 1931 is higher throughout the city than in 1928, we have no *a priori* reason to assume that the relationships between dependency and delinquency and nativity have changed markedly. Entering Table I with  $r_{jk} = r_{23} = .60$  and  $r_{jj} = r_{22'} = .80$ , we find  $\lambda = 1.089$ . Hence, we estimate by Equation 3m,  $r_{1(2+2).3} = 1.089 \times .65 = .71$ , and conclude that with the use of a more reliable index of dependency  $r_{1(2+2).3}$  will lie somewhere between .65 (which is  $r_{12.3}$ ) and .71. In this case, actual data happen to be available, p. 218, namely,  $r_{12'} = .77$ ,  $r_{22'} = .90$ , and  $r_{2'3} = .64$ , permitting us to use Equation 3l, from which we calculate  $r_{1(2+2).3} = .69$ .

It is hoped that this paper will interest research workers sufficiently to encourage further exploration of the theoretical approaches here examined. Further empirical study of the range of safety in the use of the approximation formulas also is desirable. From the standpoint of application if there is a hesitance, because of the time required, to use these or better methods which subsequent students may develop, one can say only that an extra few minutes spent in analyzing one's correlation problem is a trivial amount of time as compared with the time taken to collect or reduce the data.

## STATISTICAL METHOD AND INDUSTRY IN GREAT BRITAIN

BY EGON S. PEARSON

**T**HE TERM statistics is understood in so many different senses that it is important to make clear at the outset of this article with which aspect of the subject I am concerned. It is with that branch of the theory of statistics which is closely associated with the theory of probability. Since in any study of the quality of material which he purchases or manufactures, the industrialist is often compelled to draw inferences regarding the aggregate from a part or sample only, it follows that he is concerned with probability rather than certainty. This is the case whether he is dealing with the assessment of risks involved in some decision, with the determination of the most efficient sampling inspection plans, with an analysis of the causes of variation in quality or with the interpretation of experimental results, whether obtained in the research laboratory or under production conditions.

That problems of this type are essentially statistical has for long been recognized by a number of individual workers in industry, but it is only within the last few years that any organised attempt has been made to bring these workers into contact with one another and to establish a link between them and the statisticians engaged in other fields. It is pleasant to record that the advance of this movement in England owes much to the stimulus resulting from the visit to London in May, 1932, of Dr. W. A. Shewhart of the Bell Telephone Laboratories. Dr. Shewhart not only gave a series of lectures in the University of London on the uses of statistical method in the control of equality, but with the backing of such powerful organisations as the American Society of Mechanical Engineers, the American Standards Association and the American Society for Testing Materials was able to convince a number of men outside the academic field that there was something in this statistics business.

Much of the recent development in the theory of statistics has arisen in answer to a need for improved tools with which to handle problem in biological and agricultural research. The need here has been not only to interpret observational data, but to organise the planning of experiments so that they are likely to lead to conclusive results. With the knowledge that a steadily widening circle of scientific workers have accepted and welcomed the aid which he can give, the statistician might well feel confident that the value of his tools will be ultimately

recognized in the same way by those who are concerned with the scientific development of industrial efficiency. But faith without action is not enough. An absolutely essential step is the development of that contact between the statistician and the practical industrialist without which it is impossible for the former to learn how best to describe his wares in simple language, or to find real illustrations of their value which will convince the hard-headed business man to whom the neatness of a theoretical solution or the precision of an error determination mean nothing. As one who has been kept in touch with similar activities in the United States I am very glad to take the opportunity offered me by the Editor of the JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION to give an account of some of the ways in which this contact between the statistician and the industrialist has developed during the last few years in Great Britain.

#### THE BRITISH STANDARDS INSTITUTION

As the result of a conference, held during Dr. Shewhart's visit to London, to which the British Standards Institution invited representatives of manufacturing industries and others interested in the application of statistical methods, a committee was formed whose main objective was to report on the application and use of statistical methods in standardisation and specification of quality. The work of this committee has recently taken shape in the publication by the British Standards Institution of a small handbook<sup>1</sup> put together by the present writer in collaboration with the committee. Among other things its object has been,

- (1) To provide a wide circle of readers with answers to the questions, Why is this technique needed? In what does it consist? What kind of assistance can it give?
- (2) To give those who wish to apply the methods a reference book in which to find set out elementary methods, terminology, formulae, tables, etc., as well as a variety of practical illustrations.
- (3) To show how the problem of securing conformity to a specification is essentially a statistical one in all cases where conclusions regarding a consignment have to be drawn from a sample selected therefrom; to discuss methods of dealing with this problem.

The committee were fully aware that this publication represented no final word on the subject; their purpose was to create interest, to

<sup>1</sup> *The Application of Statistical Methods to Industrial Standardisation and Quality Control*. B.S.I. No. 600-1935.

arouse discussion and comment, and so to make it easier to determine how far and in what ways statistical method can be most effectively introduced as an aid to the attainment of industrial efficiency.

#### RESEARCH STATIONS AND INSTITUTES

There are in this country a number of Research Stations attached to the Department of Scientific and Industrial Research as well as a wider circle of Research Institutes or Associations which form a link between that Department and the more important industries. In a number of these the use of statistical method has been established. The value of this technique in the planning and interpretation of routine tests and experimental research is quickly recognized by the young scientific worker whether he be physicist, chemist, engineer or biologist, and after some initial direction and guidance the statistical approach is acquired as a habit rather than assumed with an effort. Evidence that this approach has been accepted will be found, for example, in work published from the Building Research Station, the Forest Products Research Laboratories, the Fuel Research Station, the British Cotton Industry Research Association and the Woollen Industries Research Association.

On a recent visit to the Shirley Institute (Cotton Industry Research Association) near Manchester, on the occasion of the opening of a series of new Laboratories, I was particularly struck by the way in which the most modern statistical technique had become absorbed into the general procedure, whether this was connected with fundamental research or with routine investigations carried out on defective material sent in for report from the mills. There has been a trained statistician at Shirley for about 12 years and perhaps the highest tribute that one can pay to his work is not that he has built up any large statistical department under his control, but that he has so worked that the scientific staff has become statistically minded. This I think is the ideal situation; that except in cases where new problems arise requiring more expert advice, the common tools of statistical analysis should be handled freely and with confidence by those engaged in the planning and interpretation of technical research. This widespread adoption of the statistical outlook in the Cotton Industry Research Association is perhaps one of the most important pointers that we have to what may be expected in the future.

#### THE UNIVERSITIES

The importance in the present connection of a University Statistical Department or Laboratory lies I think in the fact that there is here



some leisure to lay plans for increasing that contact between the statistician and the industrialist that is needed. I can speak only with experience of the situation as we see it in the Department of Statistics at University College, centrally placed in London, but it may perhaps be of interest if I mention some of the objectives that we keep in view.

- (1) Whenever opportunity arises, to obtain suitable data which may be turned into illustrative material showing in simple terms some of the functions of statistical method.
- (2) To direct the research of certain post-graduate students on to problems for which a solution is needed. If this involves the placing of a student for some time in a factory or its research department to watch processes or to collect data, the resulting contacts will have many advantages.
- (3) To keep in touch with students who have permanent posts in industry.
- (4) To welcome any opportunity of giving a training in statistical method to men having technical qualifications who may be sent from industry to work in the Department for a term or two, or even as part-time students.
- (5) By a few well illustrated lectures to bring to the notice of students in other parts of the College, e.g., in the Department of Chemical Engineering, the existence and meaning of statistical tools.
- (6) To provide evening lectures suitable for men already engaged in industry.

Throughout this work we are all learning, the teachers and the taught; I realise from my own personal experience how long a time it takes for the expert statistician to learn how unintelligible he may be, even when he thinks he is talking in simple language!

#### THE INDUSTRIAL AND AGRICULTURAL RESEARCH SECTION OF THE ROYAL STATISTICAL SOCIETY

This Section was formed in the autumn of 1933; its objectives have been set out fully in Part I of the Supplement to the Society's *Journal*.<sup>2</sup> By providing at its meetings a platform for discussion it plays an essential part in the movement I have described by bringing together not only the groups already referred to, but in addition the agricultural statistician. The methods of statistical analysis and the conception of planned experimentation whose origin is associated with the Rothamsted Agricultural Experimental Station and the name of R. A. Fisher,

<sup>2</sup> *Supplement to the Journal of the Royal Statistical Society (Industrial and Agricultural Research Section)* Vol. I, No. 1, 1934.

can and are being used by workers in the field of industry. As shown by its name, the Society's Research Section aims at increasing this contact between agriculture and industry.

The progress that the Section has made in the pursuit of its objectives may best be judged by reference to some of the papers that have been read before it.

The opening paper entitled "The application of statistical methods to production and research in industry" was a general survey given by Dr. R. H. Pickard, F.R.S., Director of the British Cotton Industry Research Association. Dr. Pickard spoke with the experience of one whose job is to collaborate with many people in industrial research work and who has felt, as he described it, the urgent necessity of applying statistical methods to a great deal of the work which is carried on by his colleagues.

The second paper on "Statistics in agricultural research" by Dr. John Wishart contained a clear description of much of the statistical technique developed in this country during the preceding 12 years. The methods of analysing the variation of heterogeneous material and the problems of sampling which it described are clearly of first rate importance in much industrial as well as agricultural research. The third paper on "Sampling problems in Industry" by the present writer discussed some of the wide variety of forms in which these problems arise.

There have since been two contributions from the Research Institutes of which I have spoken. Mr. B. H. Wilsdon, then at the Building Research Station, and now Director of the Woollen Industries Research Association, read a paper entitled "Discrimination by specification statistically considered and illustrated by the standard specification for Portland cement," and Mr. L. H. C. Tippett of the Cotton Industry Research Association gave a paper on "Some applications of statistical methods to the study of variation in quality in the production of cotton yarn."

After two years of activity there was a feeling that the discussions of the Section had not yet been of a kind which would catch the interest of the practical man who had little or no knowledge of statistical technique and terminology. The committee of the Section therefore decided to arrange for one or two discussions which would centre round an actual problem, presented by an industrialist, that had arisen in the course of the production with which he was concerned. The statisticians should then describe in as simple terms as possible the methods which they would use in interpreting the data already collected or in planning further investigation.

Following these lines a paper was presented last November by Messrs. Dudding & Jennet of the General Electric Co., Ltd., (England) dealing with a problem that had arisen in research into the quality of electric lamp filaments. An excellent discussion followed in which among other things, use was made of models and diagrams to illustrate the meaning of partial and multiple regression. A similar discussion is planned at the Section's Meeting in May when Dr. Hampton and Mr. Gould of Chance Bros. & Co., Ltd. (Glassmakers), will present a paper dealing with a problem with which they have been faced in the manufacture of spectacle glasses. This problem provides good material for illustration of the use of the methods of analysis of variance in picking out the factors in the production process which seem to be associated with greatest variation in quality.

## LEGAL ASPECTS OF STATISTICAL ACTIVITIES OF TRADE ASSOCIATIONS WITH SPECIAL REFERENCE TO THE SUGAR INSTITUTE DECISION

BY CHARLES J. BRAND, *Executive Secretary and Treasurer*  
*The National Fertilizer Association*

ON MARCH 30, 1936, the Supreme Court of the United States handed down its decision in the case of The Sugar Institute, Inc., the American Sugar Refining Company, and other appellants. The case was in the Supreme Court on appeal from the decision by Judge Julian W. Mack rendered March 7, 1934, in the District Court of the United States for the Southern District of New York. The suit was brought in March, 1931, in the lower court by the Department of Justice to dissolve The Sugar Institute, Inc., a trade association organized in 1927 by fifteen of the largest cane sugar refiners in the United States.

The organizers of the Institute had proceeded with the encouragement of the Department of Commerce and after conferences with the Department of Justice. A "Code of Ethics" under which the Institute was to operate was prepared by the refiners with the assistance of able counsel. In advance of operating under it the code was submitted to the Department of Justice for criticism and suggestions. It is understood that the Department gave such approval to the code as was warranted in the circumstances, but specifically reserved its freedom of action should it appear at any time that operations under the code had brought about or were likely to bring about unlawful restraint of trade.

The main feature of the "Code of Ethics" was the so-called "basic agreement" which provided that: "All discriminations between customers should be abolished. To that end sugar should be sold (by the refiners) only upon open prices and terms publicly announced." There was no agreement to fix prices, nor did the government allege any such agreement. As the Supreme Court pointed out, "the distinctive feature of the 'basic agreement' was not the advance announcement of prices, or a concert to maintain any particular basis price for any period, but a requirement of adherence, without deviation, to the prices and terms publicly announced."

Rarely has a case been prepared and tried more carefully. The testimony covered over 10,000 pages and included in addition over 900 exhibits. The opinion of Judge Mack covers 146 single-spaced mimeographed pages. It has never been printed and hence is not conveniently available to students of economics and statistics.

## SUMMARY OF DECREE OF THE COURT BELOW

Judge Mack's decree filed on October 9, 1934, perpetually enjoined and restrained appellants from following 45 specific lines of action which were set forth in a like number of paragraphs describing each prohibited practice in appropriate detail.

Paragraph 1 prohibits effectuation of any plan to give the same terms, conditions, or freight applications to customers irrespective of the varying circumstances surrounding particular transactions or classes of transaction, and regardless of the varying situations of the customers with whom business was transacted.

Paragraph 2 prohibits selling only upon or adhering to prices, terms, conditions, or freight applications announced, reported, or relayed in advance of sale, or refraining from deviating therefrom.

Paragraphs 3, 4, and 5, quoted verbatim later herein, prohibited competitors from systematically and by agreement exchanging among themselves or reporting to a common agency, information as to current or future prices, terms, conditions, or freight applications, or lists or schedules thereof; from relaying such information by or through The Sugar Institute; and from giving prior notice of changes or contemplated changes, or relaying, reporting, or announcing changes in advance.

Paragraph 6 prohibits restraints on repricing.

Paragraph 7 deals with statistical information per se and prohibits the collection and/or dissemination even of such statistics as have hitherto been regarded as altogether lawful unless they are made appropriately available to the sugar buying and distributing trade. This paragraph is also quoted verbatim elsewhere in this article.

Paragraph 8 prohibits pressure upon third parties to accept and follow any program enjoined by the decree.

Paragraph 9 prohibits agreeing to meet, suppress, or restrain prices, terms, conditions, or freight applications of particular refiners or distributors.

Paragraphs 10 to 45 prohibit any agreement or concerted action with respect to each of the acts, trade practices, rules, policies, code provisions, or interpretations set forth in the separate paragraphs, such as:

1. Restraints on brokers and warehousemen by boycotting them for engaging in more than one distributive function.
2. Transportation restraints, particularly agreeing to sell only at delivered prices.
3. Concerted reduction in the number of consignment points.

4. Concerted prohibition on long-time contracts and quantity discounts.
5. Restraints on the sale of damaged sugar and so-called frozen stocks and upon resales of sugar.

#### DISCUSSION OF STATISTICAL ASPECTS

The legal status of so-called statistical information that a trade association may collect depends on whether the information collected really constitutes statistics.

The science of statistics deals with the collection, tabulation, and dissemination of facts. A fact is a thing done; an act performed or an incident transpiring, an event or circumstance. Court decisions also uphold the view that an event mental as well as physical is a fact.

The statistical activities of The Sugar Institute included the collection and dissemination of information on a wide variety of subjects pertinent to that industry. Among these were:

1. Production
2. Sales
3. Deliveries
4. Stocks on hand
5. Refining capacity
6. Stocks on consignment
7. Quantities moving at differential rates
8. Quantities moving over differential routes
9. Stocks in transit
10. Sales for export
11. New business
12. Stocks in consumers' warehouses

There is no indication that statistics covering prices in past transactions were included. All information concerning the business operations of the members and coöperating non-members was exceedingly intimate and detailed. The inaccessibility of Judge Mack's decision warrants quoting from it of the detailed statement as to statistics. Beginning at the middle of page 16 of the mimeographed opinion, Judge Mack says:

I shall consider separately statistical matters relating to data (1) collected by the Institute (2) that as to which the Institute did not concern itself.

1. Most important among the Institute's statistical services exclusive of price and terms reports are the following: (all reports were compiled chiefly from data supplied by defendant refiners.)

(a) Each week the Institute sent out an individual report to each refiner

showing the total weekly melt (i.e. production), deliveries and stock on hand of all members and the percentage thereof of the refiner so notified.

(b) The Institute reported weekly the melt and deliveries for the week of each member as well as his cumulative total melts and deliveries from the beginning of the year to the end of such week. Key letters were used to designate the several refiners; each refiner had a code of all designations.

(c) At the end of the contract period on each price move, a report or reports were sent out showing for each refiner the total undelivered and unspecified sugar on the contracts. Reports were also sent out showing by states the total amount of undelivered sugar for each refiner; here too, the key letters were used instead of names.

(d) Reports of capacities of the several refiners were circulated several times during the Institute period.

(e) An annual compilation of statistics collected by the Institute with analyses thereof was sent out.

The foregoing reports were furnished to each of the Institute members but to them alone.

(f) A quarterly statistical report was sent to Institute members and a few others, chiefly representatives of off shore refiners.

(g) A weekly report showing total deliveries in each state for such week by all refiners but not by each of them, was sent to the Institute members, Hershey and its sale representative.

(h) Each month a report showing total deliveries by states of all refiners for the month, together with a comparison with the same in each of the four years immediately preceding and the same data for the year to the end of such month, was sent to the same parties.

(i) A weekly report showing by states with some subdivisions thereof total sugars on consignment at consignment points for all refiners but not for each of them, was sent to the same parties.

(j) A similar report showing in-transit stocks was sent weekly to the same parties.

(k) Reports showing the amount of sugars moved into each state during the week by all the important differential routes<sup>1</sup> for refiners own account and separately, at customers' request, together with some analyses thereof were sent to the same parties; some such reports were also sent to L. W. & P. Armstrong, representatives of an off shore refiner.

(l) A monthly report showing the total cane and beet sugar deliveries separately by states was sent to Institute members, the Domestic Sugar Bureau and several representatives of off shore refiners.

With the foregoing description of The Sugar Institute and its operations, particularly its statistical activities, before us, we may proceed in the light of previous decisions to some evaluation of the effect of the decision in this case on the statistical activities of trade associations. It should perhaps be added that the refiners who were members of The Sugar Institute controlled between 70 and 80 per cent of the total sugar refined in the United States.

<sup>1</sup> That is, by water and combination water and rail routes, carrying lower freight rate than all rail service.

The decree of the lower court with respect to statistical activities, excluding the part that relates to the reporting of prices and changes of prices under the Institute's open price plan, enjoined, restrained, and prohibited, individually and collectively, members of the Institute, in connection with the sale, marketing, shipment, transportation, storage, distribution, or delivery of refined sugar, from engaging or attempting to engage, directly or indirectly, with one another or with any competitor, through any program, in:

7. Effectuating any system of gathering and/or disseminating statistical information regarding melt, sales, deliveries, stocks on hand, stocks on consignment, stocks in transit, volume of sugar moved by differential or other particular routes or types of routes, new business *or any other statistical information of a similar character*, wherever and to the extent that said information is not made or is not readily, fully and fairly available to the purchasing and distributing trade. (*Italics added.*)

The point of greatest significance in this prohibition is that when producers see fit to gather statistical information that is of legitimate interest to the purchasing and distributing trade it must be made readily, fully, and fairly available to such trade.

The Supreme Court upheld the prohibitions of paragraph 7 of Judge Mack's decision quoted above, except that it ordered to be stricken therefrom the italicised words, "or any other statistical information of a similar character," and the insertion of the word "and" before the words "new business." The general effect of paragraph 7 as changed, therefore is to permit the collection of a very wide range of statistical information, provided only that it is made available appropriately to the purchasing and distributing trade.

It is fairly inferable from the earlier cases that were carried to the Supreme Court, including the American Column and Lumber case, 1921 (257 U. S. 377), the American Linseed Oil Company case, 1923 (262 U. S. 371), the Maple Flooring Manufacturers Association case, June 1, 1925 (268 U. S. 563), and the Cement Manufacturers Protective Association case, June 1, 1925 (268 U. S. 588), the Supreme Court held and holds lawful the work of trade associations involved in *openly and fairly gathering and disseminating* information as to:

1. Cost of product.
2. Volume of production.
3. Actual price the product had brought in past transactions.
4. Stocks on hand.
5. Approximate cost of transportation from principal point of shipment to points of consumption.



6. Meeting and discussing such information and statistics without reaching any express or implied agreement or concerted action with respect to prices or production or restraining competition.

The Sugar Institute opinion is strictly in line with the views expressed by the court in 1921 in the Column and Lumber case in which the court especially objected to the fact that "published reports . . . go to sellers only." In the latter case the court adopted the method of stating a large number of activities or types of conduct that would be considered either questionable or undoubtedly illegal if engaged in by members of the unincorporated American Hardwood Manufacturers Association. Among these were the following:

1. Predictions in writing, sent to the manager of statistics and distributed by him, that high prices prevailing as shown by reports would continue to be maintained and enhanced.
2. Expositions of the theory that if each defendant had knowledge of existing prices, such knowledge would be sufficient to keep prices stable at normal levels even in the absence of agreement.
3. Sending out questionnaires and subsequently editing the answers and distributing a summary among members tending to show that the open pricing plan of the association produced a steady advance in prices.
4. Printing and distributing among members arguments against low prices based on reports of stocks on hand.
5. Urging members against increase of production by working night crews.

It is readily apparent, even to the layman, that the activities above described were not statistical. They were related to the collection and analysis not only of statistics but also of collateral material, and involved an unlawful use of the materials. Facts, views, prophecies, and other matter that did not constitute statistics were edited and then disseminated in such a manner as to involve an attempt to control conditions as they might arise in the future. Even data that were in fact statistical were used unlawfully.

In the American Linseed Oil Company case, involving the services of the Armstrong Bureau of Related Industries to the Linseed Oil Council, the Supreme Court dealt with the illegality of collecting and using data that were not statistical, but of such a nature as inevitably to "have only one purpose and effect, namely, to restrain competition among sellers." In this case real statistical data were gathered as well

as reports that were not statistical, e.g., the names of prospective buyers. The collection and dissemination of such information as did not constitute statistics when used in conjunction with the whole general plan were found to be illegal.

The decision of the Supreme Court in the Sugar Institute case has given us the most recent judicial interpretation as to what statistical data may be considered to be within the realm of absolute legality.

Earlier in this paper we quoted verbatim the description of the statistical work of the Institute as set forth in Judge Mack's opinion. Certain of the information gathered was furnished only to the members of the Institute. A part was furnished to members of the Institute and other competitors, both foreign and domestic. Another and minor part was given a certain degree of public dissemination. With the minor excision from paragraph 7 of the decree of the lower court given above, the Supreme Court upheld Judge Mack's decision as to statistical information. In its decision the court found that the data being collected and disseminated by the Institute were such that the purchasing and distributing trade had a legitimate interest in them and that they should be made available to the trade and the purchasing public.

#### OPEN PRICING

Although the price reporting activities of The Sugar Institute and its members also constitute a statistical activity in a sense, it is not my purpose to discuss them in detail in this paper.

The Supreme Court attached some importance to the facts that the appellants emphasized the desirability of a more nearly perfect competition and professed a policy of fostering such competition through prices, terms, and conditions publicly announced in advance of sale, and adhered to without deviation or discrimination.

Paragraphs numbered 3, 4, and 5 of Judge Mack's decree dated October 9, 1934 (equity 59-103), perpetually enjoined, restrained, and prohibited the Institute from:

3. Effectuating any system for or systematically reporting to or among one another or competitors or to a common agency, information as to current or future prices, terms, conditions, or freight applications or lists or schedules of the same;

4. Relaying by or through The Sugar Institute, Inc., or any other common agency, information as to current or future prices, terms, conditions or freight applications, or any list or schedule of the same;

5. Giving any prior notice of any change or contemplated change in prices, terms, conditions, or freight applications, or relaying, reporting, or announcing any such change in advance thereof;

The effect of these paragraphs of the decree of the lower court, had they been allowed to stand, would have been gravely to discourage lawful and fair anti-discrimination open pricing plans. Any open pricing plan becomes illegal and unfair if it involves any direct or collateral express or implied agreements as to what the prices openly announced shall be. Likewise, the utilization of coercion, intimidation, or reprisals in connection with prices constitutes an illegal use which causes the plan itself to become illegal.

The Supreme Court ordered modification of the decree of the lower court by striking out paragraphs 3, 4, and 5, with the statement that such reporting or relaying as permits voluntary price announcements by individual refiners to be circulated and relayed by the Institute, subject, of course, to the restrictions imposed by the decree, does not appear to involve any unreasonable restraint of competition, under conditions prevailing in the sugar industry.

In the Sugar Institute case, in holding that information may be gathered as to current or future prices, terms, conditions, or freight applications, or any list or schedule of the same, the court went farther than it has gone in the past. In accordance with trade usage, future prices, terms, and conditions of sale, and notices of contemplated changes, may be collected and disseminated by an association. The dissemination of this information to the purchasing and distributing trade, however, must be complete enough to afford them sufficient knowledge of commercial conditions and give them an equal advantage in the Association's collected data, insofar as they have a legitimate interest. In these circumstances, the activities of associations in compiling information are not limited to past transactions.

The court, in holding that information collected should be made readily, fully, and fairly available to the purchasing and distributing trade and to other persons having a legitimate interest therein, did not take the position that all statistical data collected must be disseminated. In fact the court held that there might be details of information received that might rightly be treated as having a confidential character, in which distributors and purchasers had no proper interest. It is obvious from the opinion that this confidential information must be rather limited, as for example, cost data, credit information, and business volume of individual enterprises.

#### CONCLUSION

The legal status of so-called statistical information which a trade association may collect is one which depends almost entirely upon whether or not the information so collected in reality constitutes statis-

tics. The legality of collecting and tabulating facts about things that have been done or occurrences that have taken place, as distinguished from information relating to things that have not happened and may never happen, is scarcely open to challenge.

As to the dissemination of statistical information, the opinion in the Sugar Institute case leaves no doubt that data collected by an institute or association composed of producers, if it hopes for legal protection, must be disseminated to the purchasing and distributing public insofar as they have a truly legitimate interest therein.

As to both collection and dissemination of information pertaining to any trade or industry, trade organizations are in no sense curbed by the Sherman anti-trust law so long as the information pertains to actual facts and is not gathered or disseminated to foster or promote any illegal combination in restraint of trade. Within the sphere thus defined, business organizations seem to be perfectly free to compile and disseminate any type of statistical data which may be of interest or benefit to the members of the industry, provided always that dissemination is not discriminatory. Associations must be careful not to restrict accessibility or release of information collected in any way that will deprive the purchasing public of benefits obtainable from information in which it has a legitimate interest.

## THE POISSON DISTRIBUTION AND THE SUPREME COURT

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IT IS OBVIOUSLY impossible for a President-elect of the United States to measure the burden which the various tasks of the Presidency will impose upon him. Even those duties which are specifically prescribed by the Constitution are largely of a contingent character, and their extent cannot be accurately forecast. Certain such predictions of the amount of labor entailed in the various duties, even though they cannot be made exactly, undoubtedly would yield to statistical treatment aiming at estimation in terms of probabilities. But on the whole, such computations would be of virtually no practical utility and of very little interest even as purely statistical exercises.

There is however, one problem of estimating a burden which will be imposed by the Constitution upon a President-elect to which, conceivably, somewhat more than academic interest might sometimes attach. That problem relates to the duty stated in Article II, section 2, which requires that : "The President . . . shall nominate and by and with the advice and consent of the Senate shall appoint . . . judges of the Supreme Court . . . ."

In order to estimate how often a President will be called upon to perform this duty, it is necessary to estimate the number of vacancies on the Supreme Court which will occur during the four years of an administration. The most obvious approach to this problem is through the use of mortality tables. But, obvious as is the approach, the limitations making it totally unfeasible are even more apparent. If "the Supreme Court is the most successful health resort in the world," as has been alleged (without, at least to the present writer's knowledge, adequate statistical justification), then no life expectancy table short of one based on the vital statistics of Justices of the Supreme Court would prove adequate; and, of course, the available data of this sort are not sufficient to provide even an approach to the statistical stability requisite in a life expectancy table. Furthermore, the constitutional duty of making appointments to the Court arises not only from deaths but also from voluntary retirements. An additional overwhelming complication involved in this approach is the necessity of estimating the probable ages of new appointees if the calculations are to prophesy

for any length of time, even a year or two. In the face of all these difficulties it seems the better part of wisdom to abandon the search for a basis from which to calculate a priori probabilities, and to seek an empirical method of estimating the chance of vacancies on the Court.

Let us suppose that in January, 1933, for some reason, we were required to estimate the number of vacancies in the Supreme Court which would occur during 1933, during 1933 and 1934 combined, during 1933, 1934, and 1935 combined, etc.; and that we were also required to supply fiduciary limits for our estimates, in order to indicate the degree of confidence which might be placed in them.

If we go over the records of the Court and tabulate the number of vacancies filled each year, we find the distribution shown in Table I, in which the total interval from 1790 to 1932, inclusive, is divided into three periods according as the membership of the Court was six, seven, or nine members.<sup>1</sup>

While Table I indicates that the empirical probability that all members of the Court will survive a given year is  $89/143$  (.622) for the total period or  $59/96$  (.615) for the period 1837-1932, inclusive,

TABLE I

Number of years in which specified numbers of vacancies in the Supreme Court were filled, for the period 1790-1932, inclusive, and for the sub-periods 1790-1806, 1807-1836, and 1837-1932.

Number of Vacancies	1790-1806	Number of Years		Total
		1807-1836	1837-1932	
0	7	23	59	89
1	9	5	27	41
2	1	2	9	12
3	0	0	1	1
over 3	0	0	0	0
Total	17	30	96	143

it is desirable in making the estimates to find a function describing the series as a whole, in order to avail ourselves of all the observations and in order to have an indication of the reliability of the conclusions. For this purpose a Poisson distribution proves an excellent function on which to base our estimates. To fit a Poisson function to this set of observations is to assume implicitly that a particular vacancy is equally likely to occur in any of the 143 years (or, for the last sub-period, in any of the 96 years), and that the probability of its actually occurring in any specified year is small.<sup>2</sup> We are to regard the vacancies

<sup>1</sup> The data are, in the main, taken from the 1936 *World Almanac*, page 227; but since only those appointments which resulted from vacancies are tabulated, the *World Almanac* data were supplemented by reference to Charles Warren, *The Supreme Court in United States History*, Boston, 1932. Those appointments which resulted in increases in the size of the Court or in promotions within the Court are excluded on the grounds that our present concern is with estimating the amount of unavoidable work which the President-elect might anticipate on the basis of the existing setup of the Court.

<sup>2</sup> The two best discussions of the theoretical aspects of the Poisson function are contained in the original derivations of the function by the two writers who discovered it independently from quite distinct approaches. S. D. Poisson, *Recherches sur la Probabilité des Jugements en Matière Criminelle*

not as phenomena attached to the particular men of whose careers they mark the termination, but as phenomena attached to particular Justiceships, or, better, to the Court itself; hence the vacancies may be regarded as a homogeneous group of events whose distribution among the 143 years is random. There is, however, a sense in which the vacancies are not independent of each other; that is, the occurrence of a vacancy during any given year slightly reduces the probability of another vacancy occurring that same year, because of the likelihood that the average age of the Court will be lowered by a new appointment. This interrelation would be of some significance if the data included cases in which major portions of the Court were replaced in a single year, or what is related to this, if the data revealed cycles, with long periods in which no vacancies occurred followed by periods of frequent vacancies; actually, however, neither of these characteristics appears in the data.<sup>3</sup>

Only the data since 1837 are used in computing the estimates. Throughout this period the institutional status of the Court has been much as at present; and, with the negligible exception of the period 1863-1867 (when there were ten Justices) the size of the Court has been constant at nine members.

From Table I it is computed that during the 96 years from 1837 to

*et en Matière Civile*, Paris, 1837, sections 73 (pages 189-190) and 81 (pages 205-207) derives the distribution to which his name has been attached as a special (limiting) case of the binomial distribution. W. C. Gosset, writing under the pseudonym "Student," "On the Error of Counting with a Haemocytometer," *Biometrika*, volume V (1906-1907), pages 351-360, deduces the Poisson function from considerations related to the frequency distribution of areas containing specified numbers of particles when  $Nm$  small particles are spread at random over a surface divided into a very large number,  $N$ , of equal areas.

L. von Bortkewitsch, *Das Gesetz der Kleinen Zahlen*, Leipzig, 1898, accepting the form of the distribution as given by Poisson, discusses its statistical characteristics and applies it to a number of cases—it was von Bortkewitsch who provided that classic example relating to Prussian cavalrymen killed by horses' kicks, which is almost universally used in textbooks to illustrate the Poisson distribution. Giorgio Mortara, "Sulla variabilità di frequenza alcuni fenomeni demografici rari," *Annali di Statistica*, series V, volume IV (1912), pages 5-61, develops a criterion of the applicability of a Poisson function and, in this paper and in one on "Le variazioni della mortalità da generazione a generazione in Svezia," *loc. cit.*, pages 63-81, applies the function to a number of sets of data. Lucy Whitaker, "On the Poisson Law of Small Numbers," *Biometrika*, volume X (1914-1915), pages 36-71, considers the theoretical aspects of the function and criticizes at length the applications made by Gosset, von Bortkewitsch, and Mortara.

The best practical discussion of the use of the Poisson distribution is given by R. A. Fisher, *Statistical Methods for Research Workers*, section 15. H. E. Soper's paper, "Tables of Poisson's Exponential Binomial Limit," *Biometrika*, volume X (1914-1915), pages 25-35, gives for values of the mean between zero and fifteen, by steps of one-tenth unit, the theoretical relative frequencies corresponding to each value of the abscissa for which the expected relative frequency is as great as .000001—though as a matter of fact, if one has at hand a table of logarithms the theoretical frequencies may be easily and quickly computed from the fact that they are the successive terms in the expansion of

$$P = e^{-m} \sum_{x=0}^{\infty} \frac{m^x}{x!}.$$

<sup>3</sup> It might be expected that the appointment of an entire Court in 1789 would have introduced such cycles; one might anticipate a period of no vacancies, followed by several grouped together. Actually, however, the Supreme Court was of scant importance and transacted but little business during its first years, with the result that Justiceships were regarded sufficiently lightly to permit frequent resignations; in fact, the number of appointments per year is greater for the first of the three periods of Table I than for either of the others.

1932, inclusive, there occurred 48 vacancies in the Court, an average of .5000 per year. From the Poisson distribution determined by this value of  $m$ ,<sup>4</sup> the probabilities of various numbers of vacancies occurring in a year are computed and converted into expected frequencies for comparison with the observed frequencies, as shown in Table II.

TABLE II

Probability of a given number of vacancies in the Supreme Court being filled within a year, as computed from the Poisson distribution for  $m=.5000$ ; the expected number of years out of 96 in which a given number of vacancies will be filled; and the actual number of years during the period 1837-1932, inclusive, in which a given number of vacancies were filled.

Number of Vacancies	Probability	Expected Frequency	Observed Frequency
0	.6065	58.226	59
1	.3033	29.113	27
2	.0758	7.278	9
3	.0126	1.213	1
over 3	.0018	0.170	0
Total	1.0000	96.000	96

The value of  $\chi^2$  between the expected and observed frequencies shown in Table II, as computed by combining the "3" and "over 3" lines, is 0.6771; and since there are two degrees of freedom,<sup>5</sup> we find that if the true distribution were as described by the Poisson function for  $m=.5000$  the probability of obtaining by random sampling a distribution differing from it as much as does this set of observations is  $P=.713$ . An additional check on the conformity of the observations to the Poisson distribution is provided by the fact that for a Poisson distribution the mean and the variance are equal. Computation from the distribution observed for the period 1837-1932, inclusive, provides as the estimate of the variance the value  $s^2=.5053$ . Again referring to the sampling distribution of sums of squares, we find that the probability that random sampling would yield an observed variance differing this much from a population value  $\sigma^2=.5000$  is  $P=.914$  (there being in this case 95 degrees of freedom for a  $\chi^2$  of 96). This value of  $P$  indicates that if  $m$  and  $s^2$  were independent, random sampling would result in such close similarity in less than nine per cent of draws of this size; and it therefore creates a presumption that the distribution describing the data should have its mean and variance equal. The hypothesis of a Poisson distribution may, therefore, be regarded as in conformity with the data. It provides us with a basis for making the required estimates, which may be found readily by application of elementary probability principles.

<sup>4</sup> For the Poisson distribution the arithmetic mean is a *sufficient statistic*; i.e., it alone includes all of the information relevant to fitting the function which can be obtained from the observations. cf., R. A. Fisher, *Statistical Methods for Research Workers*, section 3.

<sup>5</sup> Two degrees of freedom are lost from the maximum of four because (1) the mean and (2) the total frequency of the theoretical distribution are determined by the observations whose conformity is to be tested.



As an illustration of the actual calculations from the distribution let us consider  $p$ , the probability that during a given year one or more vacancies will be filled, and  $q$ , the probability that during a given year no vacancies will be filled. We have already seen that  $q = e^{-.5000} = .6065$ , whence  $p = .3935$ . But in order to be on the safe side we may wish to use a probability so conservative that there is little likelihood of its being an overestimate; that is, we may wish to find a value of  $p$ ,  $p'$ , so low that if it were the true probability there would be only one chance in twenty that random sampling would yield an observed probability deviating from it as much as does the value  $p$  calculated from these observations. For this we take  $m' = m - 1.96s_m = .3578$ . Taking  $q' = e^{-.3578} = .6894$ , we find that  $p' = .3016$ .

In Table III are given the probabilities that one or more vacancies will occur (and also the complementary probabilities that none will

TABLE III

Probability that one or more vacancies in the Supreme Court will occur during specified numbers of years (together with the complementary probabilities that no vacancies will occur during the same periods), computed both from the most likely value and from the lower fiduciary limit ( $P = .05$ ) of the probability that within a given year at least one vacancy will occur (as determined from data covering the years 1837-1932, inclusive).

Number of Years	Probability			
	Best Estimate		Lower Fiduciary Limit	
	None	One or More	None	One or More
1	.61	.39	.70	.30
2	.37	.63	.49	.51
3	.22	.78	.34	.66
4	.14	.86	.24	.76
—	—	—	—	—
5.99	.05	.95	—	—
8.35	—	—	.05	.95

occur) for given periods of years from January, 1933, using both the most likely value of  $p$  and its lower fiduciary limit,  $p'$ .

In point of fact, of course, there have been no vacancies in the Supreme Court during the first three years of the term of office of the present President. At the time he took office, however, he might have estimated with a very high degree of confidence that there was less than one chance in three that he would not be called upon before March, 1936, to fulfill his oath of office in this respect. Indeed, the *best* estimate would have been that there were only two chances in nine that no vacancies in the Supreme Court would occur during the first three years of his administration.

## ON THE COMPARABILITY OF DEATH RATES\*

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A COMPARISON of the "crude" death rates (deaths annually to 1000 inhabitants) in different countries, or in the same country at different periods, contributes to our knowledge of sanitary conditions only if the rates are not too much influenced by factors independent of those conditions. Certain population groups have naturally a high and other groups a low death rate, and the gross or average death rate of the population depends largely on the proportion which those groups make of the whole.

The most important difficulty from this source is the diverse age composition of different populations; this is surmounted as far as possible by standardization. But even that does not result in complete comparability because the age composition of the standard population adopted greatly influences the results. It is advisable, therefore, to use the "ideal" population of a life table, which yields figures of the population for which the life table speaks independent of its age distribution.

Statisticians seem to have dealt very little with the question of using a life table for obtaining comparable death rates. The reason is that life tables aim to show the expectation of life at various ages, and for that purpose death rates for the whole population are not needed. Another reason may be found in the fact that one of the principal aims of the "crude" death rate (the comparison with the birth rate) is objectless in the case of the life table population whose stationary character is founded on the perfect equality of birth and death rates.

What is the best method of calculating the death rate of an "ideal" population? I have recently dealt with this question<sup>1</sup> and will here explain in more detail the method there proposed.

Let us call *A* the sum of the 100 (or more) figures which we obtain by subtracting from a round number of new-born (as a rule, 100,000) the deaths to be expected in successive years, according to the death rates stated for each year of age. This sum *A* has several different meanings:

(a) the sum of the survivors to each year of age amongst a generation of 100,000 new-born;

\* Readers are invited to send to the author (or the Editor) their comments on this note for possible publication in a later issue of the JOURNAL. (Ed.)

<sup>1</sup> *Revue de l'Institut international de Statistique*, III (1935), pp. 129-141; esp. p. 136.

(b) the sum of the life-years to be expected at the beginning of the single years of age by the survivors;

(c) the contemporaneously living population, as it results from the "stationary" annual number of births and deaths of the past 100 (or more) years during which such population was born;

(d) the total number of years lived by that population during a year.

If we take the 100 figures and their sum in the sense of (a) or (b), they are relative to the time to come; taken in the sense of (c) they are based on the time past; in the sense of (d), on the present time. In the cases of (b) and (d) each of the 100 figures must be diminished in order to make allowance for the years not accomplished by a part of those who have reached them. In the case of (a), finally, the sum  $A$  cannot be used for any conclusion on account of the fact that those who have reached the second year are counted twice, those reaching the third year, three times, etc.

None of these different meanings of the sum  $A$  can directly be used for calculating an annual death rate on 1000 living.

A trustworthy annual death rate of the "ideal" population can be found only by taking the figures in the sense of (c) and by the indirect way of calculating (1) the whole duration of life of the contemporaneously living "ideal" population, (2) the average duration of life deduced from this sum, and (3) the average death rate which will be the reciprocal of that average duration of life.

As to (1), we cannot calculate the duration of life of a "real" population, because we know only the years already lived by each age class. For an "ideal" population we can add the years still to be lived (according to the expectation of life) to those already lived, and thus establish the probable duration of life for each of the 100 age classes composing the "ideal" population. This will be made up of those still living among the 10,000,000 born during the preceding 100 years. Taking as an example the following table, we obtain the whole duration of life for every age class<sup>2</sup> by multiplying the figures in column 2 by those in column 5 (see col. 6). The sum of the 100 figures is 385,000,000, and this divided by the number of the living, 5,500,000, yields the average duration of life, 70 years. From this we obtain the average death rate of  $1000:70=14.29$  yearly per 1000.

<sup>2</sup> Each of the 100 figures in col. 2 of Table I ought to be diminished on account of deaths occurring during the whole year of life. Only in order to simplify the calculation, let us assume that 100,000 are born simultaneously at the beginning of the year and that 10,000 die simultaneously just before reaching the second year, 2,000 just before reaching the third year, etc. Of course such a simplification would not be admissible if we sought to calculate the exact expectation of life; but that is not the case.

A mathematician has suggested the following formula:

$$\frac{1}{2} + \frac{2(l_1 + 2l_2 + 3l_3 + \dots + \omega l)}{l_0 + l_1 + l_2 + l_3 + \dots + l_\omega}$$

$l_0$  being the number of living-born,  $l_x$  the number of those who reach the age of  $x$  years, and  $\omega$  the upper limit of age. When calculated according to this formula on the basis of a recent life table, the life-table death rate is often higher than the crude death rate. In Germany, for instance, the life-table death rate thus obtained for 1924-26, was 14.17 (see Table II), but the crude rate was only 11.91. The difference results from the decrease in the death rate during the life-time of the present generation. Owing to that decrease, the proportion of aged persons in the "real" population is lower than it would be if in their

TABLE I

Living persons		Years of life			Total years of probable duration of life (2) × (5)
Age (years)	Number	already survived	to be expected	Sum of (3) and (4)	
1	2	3	4	5	6
0	100,000	0	55	55	5,500,000
1	90,000	1	60	61	5,490,000
2	88,000	2	60	62	5,456,000
...	...	...	...	...	...
80	1,000	80	5	85	85,000
...	...	...	...	...	...
100	1	100	0	100	100
Total	5,500,000				385,000,000

youth the death rates had been as low as today. Obversely, the proportion of aged in the "ideal" is higher than in the "real" population, because it is calculated on the basis of the lower present death rates in all age classes. But the decrease of the death rates in old age could not be as great as at younger ages; and so obviously the greater number of old people produces a higher death rate in the "ideal" than in the "real" population. On the other hand, if there had been an increase in mortality during the life of the present generation, the crude death rate would be higher than that computed for the "ideal" population.

Even if the death rate of the "ideal" population is much higher than the crude rate, it does not mean that sanitary conditions are worse than the crude rate indicates, since obviously the higher death rate is due to the larger proportion of persons reaching a high age.

Table II gives the results obtained by this method for some countries (col. 5) compared with the crude rate (col. 6) and with the reciprocal of the expectation of life at birth (col. 7):

It is surprising to see that the differences between the crude death rates of the four countries (col. 6) are almost entirely due to differences in age composition, and dwindle or disappear as soon as the influence of this difference is eliminated (col. 5).

Owing to the failure to examine thoroughly the problem of calculating a death rate in the "ideal" population, misunderstandings occurred where it was tried. The most frequent misunderstanding consists in not considering the fact that as the expectation of life at birth holds only for children in the first year of age, or more exactly, at the moment of birth, the death rate resulting from the reciprocal of that expectation of life also represents only the expectation of death in the first year of

TABLE II  
COMPARATIVE DEATH RATES BY THREE METHODS FOR UNITED STATES,  
GERMANY, ITALY, AND SCOTLAND

Country, year, and sex	Life table population			Death rate per 1,000		
	Total	Probable duration of life in years		of life table population in col. 4	of the real population	according to reciprocal of expectation of life at birth
		Total*	Average			
1	2	3	4	5	6	7
United States (whites) 1929-31						
Male	5,963,934	413,945,181	69.41	14.15	10.89	16.28
Female	6,318,033	454,077,063	71.87			
Germany 1924-26						
Male	5,650,271	394,812,002	69.87	14.17	11.91	17.42
Female	5,934,079	423,087,561	71.30			
Italy 1930-32	5,488,000	388,655,132	70.82	14.12	14.36	18.22
Scotland 1930-32						
Male	5,600,000	389,679,545	69.01	14.23	13.39	17.86
Female	5,950,000	428,538,511	71.87			

\* Unlike Table I, the fact that deaths occur during the year of life is here taken into account.

life, but not the death rate of the whole population. By taking such a reciprocal as a death rate of the "ideal" population one may obtain for instance a rate as high as 18.18 per 1000, if the life expectation at birth is 55 years as in Table I. Obviously in calculating an average death rate it is necessary to take into account the fact that the expectation of life *increases* during the first years and diminishes by *less* than a year annually during the rest of life. Therefore the rate 18.18, and the figures calculated in this manner in column 7 of Table II, cannot be applied to the whole population because they do not take into consideration the figures composing the sum *A*.

The mistake in such a procedure is also illustrated by the following example: If in column 2 of Table I the number of survivors at the first and second year were 91,000 and 87,000 (instead of 90,000 and

88,000), the true death rate would be lower on account of 1000 dying now in their second year instead of their first; but the death rate as calculated from the expectation of life at birth would be unchanged, remaining  $1000:55 = 18.18$  per 1000 "per annum." So we find again that no conclusion concerning the death rate can be drawn from the *sum* of a life table, as such sum might be the same for two "ideal" populations in spite of differences in their sanitary conditions.

In view of this analysis it appears that death rates resulting from the "duration of life method" give the best measure of mortality, unaffected by the differences in age composition caused by oscillations in the preceding birth rates and death rates.

## NOTES

### ORGANIZATION OF THE CENTRAL STATISTICAL BOARD

Organization of the Central Statistical Board under the terms of an Act approved July 25, 1935 (49 Stat. 498), was announced on March 11, 1936 by the Central Statistical Committee, consisting of the Secretary of Labor, Chairman, and the Secretaries of the Treasury, Agriculture, and Commerce. Stuart A. Rice, President of the American Statistical Association in 1933 and formerly Assistant Director of the Census, has been appointed by President Roosevelt as the Chairman of the new Central Statistical Board. The announcement reads as follows:

#### ANNOUNCEMENT OF THE ORGANIZATION OF THE CENTRAL STATISTICAL BOARD

Pursuant to authority vested in the Central Statistical Committee by Public No. 219, Seventy-Fourth Congress, approved July 25, 1935 (49 Stat. 498), and in accordance with the provisions of Executive Order No. 7287, dated February 10, 1936, we, the Secretary of the Treasury, the Secretary of Agriculture, the Secretary of Commerce, and the Secretary of Labor, severally, as the members of the said Central Statistical Committee, do declare by this proclamation that seven members have qualified for membership in the Central Statistical Board, created by the Act hereinbefore cited, and that said Central Statistical Board has been duly organized and that the organization was completed on March 11, 1936. The said date hereafter shall be known as the date of organization of the Central Statistical Board as provided for by the said Act and by the said Executive Order hereinbefore cited.

Dated at Washington, D. C., this eleventh day of March, A.D., 1936.

By direction and authority of the Central Statistical Committee,

FRANCES PERKINS  
Secretary of Labor  
Chairman, Central Statistical Committee

The membership of the statutory Central Statistical Board is set by the Act at not to exceed fourteen members, who are of two classes: designated members appointed in accordance with the provisions of Executive Order No. 7287, dated February 10, 1936; and elected members, who, under the terms of the same Executive Order are elected by the Chairman and the six designated members.

The part of the text of the Executive Order prescribing the method of selecting members is as follows:

The thirteen members, other than the Chairman, of the Central Statistical Board (hereinafter referred to as the "Board") established by the said act shall be selected as follows:

(a) Six members of the Board shall be *designated* members. One designated member shall be named by each of the following officers from among the officials or employees subject to his direction as such officer:

The Secretary of the Treasury  
The Secretary of the Interior  
The Secretary of Agriculture

The Secretary of Commerce  
The Secretary of Labor  
The Chairman of the Board of Governors  
of the Federal Reserve System

(b) Seven members of the Board shall be elected by the Chairman and the six designated members within two months after the date of the organization of the Board, which, for the purposes of this order, shall be the date that the Central Statistical Committee established by the said act shall declare that seven members have qualified for membership in the Board: *Provided, however*, that not less than four of such elected members shall be persons already in the service of the United States: *And provided further*, that at least one of such elected members shall be a person who is not, during his tenure of membership, a permanent paid employee of the Federal Government.

The members designated in accordance with the foregoing Executive Order are:

George C. Haas, Director of Research and Statistics for the Treasury  
Oscar E. Kiessling, Chief Economist, Mineral Resources and Economics  
Division, Bureau of Mines, Interior  
Mordecai Ezekiel, Economic Adviser to the Secretary of Agriculture  
Ernest G. Draper, Assistant Secretary of Commerce  
Isador Lubin, Commissioner of Labor Statistics  
E. A. Goldenweiser, Director of Research and Statistics, Board of Governors of the Federal Reserve System.

Six of the seven elected members have been chosen by the Chairman and the six designated members. They are:

E. Dana Durand, Commissioner, U. S. Tariff Commission  
Corrington Gill, Assistant Administrator, Works Progress Administration  
W. H. S. Stevens, Assistant Chief Economist, Federal Trade Commission  
Leonard D. White, Commissioner, U. S. Civil Service Commission  
Ernest M. Fisher, Director, Division of Research and Statistics, Federal Housing Administration  
Frederick F. Stephan, Secretary, American Statistical Association.

The seventh membership has not yet been filled.

The text of the Act under which the statutory Board will operate was printed in this JOURNAL, December, 1935 (Vol. XXX, No. 192) pages 714-716. The Board expects to continue to operate along the general lines of policy laid down in its *First Annual Report*, which covers the calendar year 1934. A *Second Annual Report* is now available.

## PROGRESS OF WORK IN THE CENSUS BUREAU

### COMPILATION OF ACCIDENT STATISTICS

The Bureau of the Census is planning to undertake the compilation of accident statistics. The Secretary of Commerce has advocated this; and the Accident Prevention Conference, which met in Washington last December upon the invitation of President Roosevelt, recommended that the Department of Commerce gather and analyze accident information. A bill mak-



ing provision for this work has been approved by the Bureau of the Budget and introduced in Congress.

No new machinery will have to be set up for compiling these statistics. The inquiry as planned will cover all deaths caused by accidents of any kind; and the existing organization of vital statistics in the United States, operating under the supervision of the Census Bureau, provides the necessary agencies for procuring the data. The certificates for deaths from accidents will be sorted out from the other certificates as they are received each month in the state registrar's office; and transcripts will be promptly forwarded to Washington, where the data can be immediately tabulated and the results published. The items on the death certificates include sex, age, race or color, and occupation of the decedent; also the place where the accident occurred distinguishing whether in industry, in the home, or in public place; also whether the injury was in any way related to the occupation of the decedent. It is obvious that these data already obtainable from standard death certificates without further inquiry will be of inestimable value as a basis for accident statistics. The compilation would be amply justified and worth while even if it never went beyond this. But for a study of the causes and the prevention of accidents, it is anticipated that additional information will be needed; and in order to secure this it is proposed to follow up a certain proportion of the accidents reported on the death certificates and obtain supplementary data on a special schedule or questionnaire. The appropriation asked for will make it possible for the Bureau to employ a special agent in each state to collect the supplementary data and otherwise aid in this undertaking. It is expected that he will work in close cooperation with the state registrar and as a rule will be located or have his headquarters in the registrar's office. The form and content of the special schedule will at the outset be more or less tentative or experimental, with the expectation that the kind and amount of detail which it is practicable and worth while to obtain will in the end be determined on the basis of actual experience.

#### NEW SERIES OF VITAL STATISTICS REPORTS

The month of January marked the inauguration by the Census Bureau of a new series of publications entitled *Vital Statistics—Special Reports*, designed to make available to the state registrars and public health officers, as well as to the general public, the most recent data released by the Division of Vital Statistics. Not only will original data be released in this manner but analytical studies and discussions of important problems in the field of vital statistics will be included, as well as news items of value to health, scientific, and public interests. These reports are rotaprinted; and in order to insure their widespread availability they will be mailed to a list of depository libraries which have agreed to preserve them, and will likewise be sent to the office of each registrar of vital statistics in states and large cities. The pages will be numbered consecutively through the year, at the end of which a table of contents and a cross index will be prepared with the idea that the series may be bound and preserved as a single volume.

Of the numbers thus far published, one (No. 4), for instance, gives the total number of deaths for the states and principal cities within the registration area for each year from 1920 to 1934, together with death rates based on estimated population; another (No. 6) gives the number of deaths in Continental United States from each cause by age, sex, and color or race for the year 1934. This corresponds to Table 6 of the annual mortality reports. Various other tabulations as they are completed will be included and published in this series of reports.

#### THE 1935 CENSUS OF AGRICULTURE

The first series of state bulletins, containing statistics of farm acreage and farm value by tenure, uses of land, and the principal crops and classes of live stock was completed in March, and the preparation of the second series was begun in February. The statistics now being tabulated cover farm population, movement from cities, farm dwellings, labor and days worked by farm operators for hire. The remaining items of the schedule not yet tabulated include fruits, vegetables, legumes, cows milked, forest products sold, and a number of minor items. A supplementary appropriation of \$200,000 has been provided which will make it possible to complete these tabulations within the next six months.

J. A. H.

#### AN OCCUPATIONAL DICTIONARY

The need felt for many years both by private and governmental organizations interested in employment and vocational problems, for a comprehensive dictionary of occupational terms has stimulated the recent undertaking of the Occupational Research Program of the United States Employment Service of a compilation of brief job descriptions for occupations which show up in employment office work to be presented in dictionary form. Similar compilations have been prepared from time to time by various organizations covering certain industries. However, due to their restriction to specific fields, these compilations are frequently of limited general use.

It is planned that the dictionary being prepared by the Occupational Research Program will at completion contain definitions of all occupations of significance in the employment field, listed alphabetically, and related to their respective industry or industries by notations following their listings. The nearest approach to such a publication printed in English is the *Dictionary of Occupational Terms*, compiled by the Ministry of Labour of Great Britain based on the census of British occupations and published in 1927. Its use in the United States is quite limited for obvious reasons.

The terminology of the proposed dictionary will be based largely on that used in the occupational classification recently developed in connection with the statistical reporting system of the United States Employment Service. This system of classification is described in detail in the March issue of the JOURNAL. In conjunction with this terminology, which was obtained largely from industrial organizations, additional sources will be tapped, such

as the several occupational reports of the Census Bureau, other governmental agency reports, and additional information from industrial agencies.

The actual job descriptions will be obtained from and checked by representatives of industries, largely through facilities offered by the Employment Service offices. This information, although it will ultimately appear with its occupational titles listed alphabetically, will be obtained according to industry, and will offer the opportunity of presenting a section for the grouping of occupational titles according to industry should it seem advisable. Information for the occupations in several industries has already been obtained by the Occupational Research Program and incorporated in job specifications, also described in the March issue of the JOURNAL. The cotton textile, laundry, automobile manufacturing, and construction industries have already been covered, and job descriptions for hotel, restaurant, retail selling, lumber and millwork, and the foundry and machine shop industries are now in the process of preparation. Except for necessary changes to be made in order to conform with the desirable dictionary manner of presentation, information contained in the job specifications is immediately available as groundwork for the proposed dictionary.

Some of the details of presentation have not yet been decided upon, but the general plan will be as follows:

1. The main title (the most usual or important term) of each occupation will appear first, in its alphabetical order, followed by alternate titles for that occupation, distinguished by a difference in printing type.
2. The name of the industry in which the occupation is usually found will be given in abbreviated form, followed by a definition or summary of duties of the occupation within that industry.
3. In instances where the same title is used within one industry for several separate jobs (types of work) each definition will be listed.
4. For definitions in which the same title applies to different types of work in each of several industries, each definition will be listed (alphabetically according to industry), preceded by the name of the industry.
5. Alternate titles will appear in their proper alphabetical order, being referred to the main title for definition by a cross index notation.

The dictionary will not be regarded as authoritative or standard with respect to legal or official usage, but will serve as a publication containing occupational definitions compiled in the light of the best available information of ordinary usage. Care will be taken to achieve accuracy and to note variations, localizing the variations wherever possible.

### NOMINATING COMMITTEE

In accordance with the provisions of the Constitution, President Joseph S. Davis has appointed a Nominating Committee to make nominations for officers to be elected at the next Annual Meeting. The members of the Committee are Robert E. Chaddock, Chairman, Leonard P. Ayres and Meredith B. Givens.

FREDERICK F. STEPHAN, *Secretary*

## A CORRECTION

By a regrettable omission in editing, certain provisional figures in the Secretary's Report as it was prepared for the Annual Meeting were not revised before the report was printed. (See this JOURNAL, v. 31, March, 1936, p. 186.) The total number of members on December 1, 1935, was 1,741 instead of 1,742 and the increase over the previous report was 118 members instead of 119 members. In the membership statement for December 31, 1935, the figure 1,640 should be 1,638.

## CHAPTER ACTIVITIES

**THE ALBANY CHAPTER.**—The Chapter had a dinner meeting March 20, 1936, at which eighteen members and guests were present. Mr. Frederick F. Stephan, Secretary of the American Statistical Association, gave a short résumé of the activities and plans of the Association. The activities of the Chapter Committee on State Statistics were discussed and the Committee authorized to enlarge its membership by inviting representatives of various state departments, irrespective of their membership either in the Association or Chapter. It was also suggested that the American Statistical Association be requested to appoint a committee on New York State statistics to work with or supplement the work of the Chapter Committee.

Professor E. H. Van Winkle of the Department of Business Administration at the Rensselaer Polytechnic Institute gave an excellent illustrated talk on "Common Pitfalls in Application of Statistical Formulae."

**THE AUSTIN, TEXAS, CHAPTER.**—After being inactive for a considerable period, the Chapter recently held two meetings. In February, a small group met informally to consider plans for regular meetings. On April 1, the first of a scheduled series of regular luncheon meetings was held at the Union Building of The University of Texas with 21 present. The principal speaker was Mr. J. C. Boyd, Jr., with the Gas Utilities Division of the Texas Railroad Commission. The title of his address was "A Statistical Study of Oil Production and Movement in Texas, 1935." Mr. Boyd explained the methods and presented the results of an intensive statistical analysis of oil production and movement in Texas made in connection with the promulgation and enforcement of proration orders by the Railroad Commission, which, under the law in Texas, is charged with this responsibility. The results of the study presented by Mr. Boyd and series of charts used in connection therewith are to be included in a forthcoming annual report of the Railroad Commission.

**THE CHICAGO CHAPTER.**—The Chicago Chapter held the third dinner meeting of its current year on January 22, 1936. Members and guests of the Chapter heard an address on the topic "An Economic Evaluation of the Oil Industry" by Dr. John W. Boatwright, Research Analyst for the Standard Oil Company of Indiana and President of the Chicago Chapter. Dr. Boatwright developed his subject by pointing out the principal determinants of

both the supply and demand of crude petroleum and its chief derivative products. Many analytical charts showing the interrelationships of supply, demand, stocks and prices were used in the presentation. The wide appeal of the subject and the speaker's approach thereto was indicated by an attendance of sixty-one even though the evening was one of the coldest on record in Chicago.

On February 19, Mr. John W. Scoville, Statistician of Chrysler Corporation, addressed a joint dinner meeting of the Chicago Chapter and the Investment Analysts Club on the subject "The Automobile Industry During the Recent Depression and Recovery." The development of the subject was illustrated by the use of many stereopticon slides. Of the total attendance of 91, over two-thirds were members of the Chapter.

Dr. Louis Wirth, Associate Professor of Sociology at the University of Chicago, addressed the Chapter on March 18 on the subject "The Role of the Urban Community in the National Economy."

**THE CLEVELAND CHAPTER.**—There have been five meetings of the Business Statistics Section during the present 1935-1936 season. At the September meeting, Professor F. W. Graff of John Carroll University was elected Chairman and Mr. J. T. Diebold of The Ohio Bell Telephone Company, Secretary. At the September meeting and at the meeting held in March of this year, the group made forecasts of business activity as reflected by the fluctuations of the Federal Reserve Board's index of industrial production. Mr. Cyril J. Bath, President of Cyril J. Bath and Company, delivered an address concerning England's recent economic recovery at the meeting in October.

Current real estate conditions in Cleveland were discussed by Mr. Raymond T. Cragin of Cragin-Morris and Company, realtors, at the December meeting. Mr. Cragin cited the drop in living unit vacancies in Cleveland from nine per cent in 1932 to four per cent at present as an indication that a housing shortage is imminent. The speaker stated that the city would experience a building labor shortage with construction only half as great as at the high point. He stated that a quarter of the building trades mechanics have died during the past decade and few, if any, have been trained. He thought that innovations and new materials will tend to reduce building costs. He said that the construction industry is not stimulated by decreased costs; that people do not build because of reduced costs but because they desire the buildings. The Annual Meeting of the Association in New York in December was discussed at the January meeting.

**THE CONNECTICUT CHAPTER.**—At a meeting of the Chapter on January 23, Professor Hudson Hastings of Yale University, discussed the various forms of inflation and the possibility of inflation in the United States in the near future. Professor Burton Camp, Wesleyan University, was elected President of the Chapter for 1936. Professor Hastings was elected Vice-President and Mr. Louis M. Nichols, General Electric Supply Corporation, Bridgeport, was elected Secretary of the Chapter. Mr. Paul Dorweiler, Aetna Life In-

insurance Company, Hartford, was elected to the Executive Committee and Mr. L. G. Flick, International Business Machines Corporation, New Haven, Chairman and Secretary of the Business Section.

A joint dinner meeting of the Regular and Business Sections was held in New Haven on March 19. Professor Fred R. Fairchild, of Yale University presented "Proposed Federal Tax Legislation" and five specially invited guests participated in the discussion.

The discussion brought out the necessity of certain exemptions, like banks and insurance companies, the danger of such a tax as a punitive measure, the desirability of allowing the reinvestment of surplus earnings for legitimate purposes of the business without penalty, and the need of some cushion in prosperous times to provide for periods of subsequent depression.

**THE PHILADELPHIA CHAPTER.**—A dinner meeting of the Philadelphia Chapter was held on March 27th, with a program of "Business Recovery." Mr. Woodlief Thomas, Assistant Director of the Division of Research and Statistics, Board of Governors of the Federal Reserve System, discussed trends in production since 1929. After emphasizing the importance of breaking down general production curves into the component units, Mr. Thomas analyzed the important trends by industries and by durable and non-durable goods. While the value of agricultural production has shown moderate variations, non-durable goods industries showed wide fluctuations and durable goods extreme fluctuations. Recovery has been most marked in the non-durable goods lines. During the past six months the durable goods industries have advanced rapidly and there are indications of continued advance.

United States Commissioner of Labor Statistics, Isador Lubin, analyzed employment trends since 1929. Employment payrolls declined to their low point in 1932-33, the index of payrolls falling to 37. The drop was much more severe in the durable than in the non-durable industries. For durable goods employment fell to 35, in the non-durable goods to 65. In payrolls the durable goods fell to 27, the non-durable to 53. In estimating unemployment in 1935 Dr. Lubin pointed out that manufacturing employment was still two million below 1929, a million and a half in the durable goods and a half million in the non-durable. These two million might eventually be reabsorbed in the building and related industries. In the manufacturing, building and service industries a total of five and a half million would need to be reabsorbed in order to bring employment back to the 1929 level. In addition, some three million have reached working age since 1929 of whom approximately a million are in school who would not have been in school if the 1929 ratios had prevailed. These figures sum up to a total of 7,400,000 unemployed and to these must be added an estimated 2 million unemployment in 1929 bringing the total unemployment to 9,400,000. Dr. Lubin pointed out that while new industries will absorb a large part of these we must look to an increase of social services such as recreation, public health and education to aid in the process.

The third speaker, Dr. Eleanor Dulles of the Department of Industrial Research of the University of Pennsylvania, analyzed recent developments in prices. Dr. Dulles found very little evidence of inflation in the United States, in fact far less than would have been anticipated by students of the problem. She emphasized four factors making for inflation: the gold status of the dollar which has not been adequately discounted in prices; governmental activities such as the NRA and the AAA; the budget deficits and government spending; the general recovery in world trade. On the other hand there were certain moderating factors working against inflation. The people in this country are not afraid of inflation and have had little experience with it; the United States was the last important country to devalue its currency and consequently there was little speculation in the currency; there was very little temptation to ship credit out of the United States. There have also been changes in fundamental cost conditions, combined with large commodity stocks in the world markets and the early stages of recovery added substantially to these. Dr. Dulles emphasized that the consumer was perhaps unconcerned with inflation largely because food prices had remained low relative to prices of the last ten years. Certainly inflation had been very mild up to the present time.

**THE PITTSBURGH CHAPTER.**—The meeting scheduled to be held in December was deferred until January 9th at which time members of the Staff of the Bureau of Business Research, University of Pittsburgh, reviewed the reports presented at the 1935 Annual Meeting of the American Statistical Association.

Instead of holding the January meeting, the Pittsburgh Chapter accepted an invitation from the Pittsburgh Personnel Association to attend a dinner and discussion of the Social Security Act, which was held on Thursday, January 23, at 6:30 P. M. at the Duquesne Club. The speaker of the evening was Bryce M. Stewart, Industrial Relations Counselors, New York.

The February meeting, held February 27th, was addressed by Professor Montfort Jones, of the University of Pittsburgh. Subject: "What is Our Gold Reserve?" and "What Should be Done With It?" Professor Jones covered the first part of the subject thoroughly, but remarked that he would prefer leaving the second part to others.

The March meeting scheduled to be held Thursday, the 26th, had to be postponed because of the flood. It would have been interesting to have held the meeting on the appointed date, in order to have listened to a recital of the experiences during the flood of those who would have been able to attend. Pittsburgh is not alone in having suffered incalculable damage in the flood stricken area, and together with others is emerging rapidly from the catastrophe.

**THE NEW YORK DISTRICT CHAPTER.**—A dinner meeting of the New York District Chapter of the American Statistical Association was held on the evening of March 3, 1936, at the Roger Smith Restaurant, 40 East 41st Street. The general topic discussed was "Stock Market Problems of 1936,"

and the presiding officer was Mr. W. W. Cumberland, of Wellington and Company.

The first speaker, L. L. B. Angas, spoke on the subject of "Investment for Capital Appreciation." The speaker addressed himself particularly to pointing out the probable differences in the rate at which profits increased in different industries during the upward stage of the business cycle—Major Angas taking the position that we have now attained the half-way point in the upward cycle.

The speaker pointed out that industries begin to revive at different stages of recovery, consumers' goods industries reviving first, the capital goods industries lagging behind. The greatest fluctuations in earning power relate to the raw material industries, construction industries and the luxury goods industries. Another group of industries whose earnings increase rapidly in business recovery consists in those industries which cater to important deferred replacement demand, as in the case of railroad equipment, automobiles and paint. The geometric industries, or those new industries such as air conditioning, Diesel engines, aircraft, etc., also offer opportunities for great increase in profits, since their sales may be expected to grow in geometric ratio.

Mr. Frank Rizzo, of Clinton, Gilbert and Company, spoke on "The Outlook for Bank Stocks for 1936." Mr. Rizzo presented data showing the extent to which the assets of banks declined from 1929 to 1933, due to the decline of deposits and the large write-offs. These declines have been followed by a two-year period in which deposits have increased, and the net annual write-offs have decreased. The speaker dwelt on the favorable factors such as the economies in operations which have been introduced, the new fields of profitable business which have been developed, and the leverage factor due to the fact that the banks' activities are in effect financed by the depositors' money.

Mr. Charles J. Collins, of Investment Counsel, Inc., Detroit, Michigan, analyzed the present technical position of the stock market, and outlined the factors which might be expected to bring about more unfavorable psychology and to signal a decline in the general level of stock prices.

Mr. James F. Hughes, of C. D. Barney and Company, speaking on the subject of "Timing of Stock Market Control" presented charts covering the period 1881-1935, which indicated that during this period of five decades the major portion of bull markets occurred while business activity was below the computed normal, whereas the major bear markets occurred after business had increased beyond the normal figure. In the 50-year period from 1880 to 1929 a bear market occurred while business was below normal in only 25 out of 600 months.

Mr. William Martin, a governor of the New York Stock Exchange and a partner of A. G. Edwards and Sons, led the discussion. Mr. Martin pointed out that whereas we should never have stock market control, we should expect to have stock market regulation. He stressed the limitations inherent in stock market technique, pointing out that there is no formula for making money on the stock market.



**THE SAN FRANCISCO CHAPTER.**—Dr. H. R. Tolley, Director of the Giannini Foundation, addressed the Chapter on December 17, 1935. His subject was "Problems in a Continuing Agricultural Adjustment Program." At a meeting of the Chapter on January 23, 1936, Dr. George W. Dowrie, Professor of Finance at Stanford Graduate School of Business, discussed the Bank Act of 1935. The Chapter met again on March 10 and was addressed by Malcolm M. Davisson of the University of California, on the subject "The Outlook for California's Tax System."

Dr. Davisson pointed out that during the last twenty-five years two outstanding developments have occurred in the field of California taxation. The first of these has been a tendency toward a more diversified state tax system with less dependence upon property taxes. The extent of this diversification may be seen from the fact that during the biennium 1935-37 the State of California will collect over \$300,000,000 in taxes. This sum will be raised from the following levies: retail sales tax, 39 per cent; gasoline tax and motor vehicle licenses, 29 per cent; bank and corporation franchise tax, 10 per cent; alcohol and beverage taxes and licenses, 7 per cent; personal income tax, 5 per cent; insurance tax, 4 per cent; and inheritance tax, 4 per cent.

The second development has been an expansion of state aid to counties and localities in order to secure more uniform and efficient performance of governmental services; the money coming from the broader tax sources open to state governments but closed to county and local governments. The expansion of state aid in California is demonstrated by the fact that during the current biennium of the expenditures of the State of California, amounting to over \$350,000,000, about 56 per cent will be turned over to counties as subventions for public schools, social welfare and highways. California, in common with a large number of other states, is at the present time facing a budget deficit. It is variously estimated at from \$25,000,000 to \$100,000,000. The situation is further complicated by the fact that several of the existing tax sources are up for a vote of the people at the November election; for instance, the retail sales tax, the personal income tax, and the chain store tax which has not as yet gone into operation.

The retail sales tax, even with the exemption of food stuffs accorded by the last legislature, is open to serious question because of the fact that it lays a disproportionately large burden upon the man of small means. Despite this defect of principle it is difficult to see how at the present moment the State can sacrifice such a productive revenue source. Those interested in an improvement of the tax system will, however, look forward to the day when fiscal conditions will make possible the replacement of the present sales tax by a more highly selective luxury tax. The personal income tax, which is being attacked currently in the press as a poor man's tax, as well-nigh impossible to administer, as costly to collect, and as destructive of enterprise and initiative, should be considered as a permanent part of our tax system to balance the very large number of regressive levies under which the State of California has always labored. These attacks upon the income tax are for the

most part fallacious and grow out of the propaganda spread by vested interests. Experience of other states, notably Wisconsin, which has used a personal income tax since 1911, gives little support to the charges of those who attack the levy in California.

The remedy for these fiscal ills does not lie in the application of an indiscriminating economy axe to governmental costs, but rather in the establishment of suitable relationships between state, county, and local governments looking toward the elimination of duplication and waste, coupled with a reasonable revenue structure with due proportions maintained between income, property, business, and commodity taxes.

WASHINGTON STATISTICAL SOCIETY.—A meeting of the Technical Group of the Washington Statistical Society was held on Friday, February 27, 1936. Howard G. Brunzman, of the Federal Housing Administration, presented a paper "Determining the Size of Samples for Measuring Changes in Rent and Vacancy." The second paper was presented by W. Arthur Shelton, Bureau of Public Roads, on "Methods of Estimating Highway Traffic Volume."

## STATISTICAL NEWS AND NOTES

BUREAU OF RESEARCH AND STATISTICS, SOCIAL SECURITY BOARD.—The economic and statistical research program of the Social Security Board is being developed in the Bureau of Research and Statistics, with Walton H. Hamilton as director and Ewan Clague as associate director. A wide variety of research functions will be performed in this Bureau when organization is finally effected. Immediate pressure exists for administrative statistics which require the maintenance of current reporting services in the fields of public assistance and unemployment compensation. These services involve co-operation with the various States.

In addition to this part of the statistical program, somewhat more comprehensive analytical statistics will be compiled from time to time. Although some of these data will be collected more or less periodically through the administrative organizations in the States, other quantitative data will be secured by special field studies based on local surveys and investigations. The field studies are to be undertaken as soon as a staff can be recruited.

This Bureau is organizing a field service to assist the States in establishing statistical divisions within those State departments dealing with public assistance and those responsible for the administration of unemployment compensation. The Federal field representatives will be located in the various regional offices established by the Board, and additional field personnel will be working from Washington, D.C. as headquarters.

Another type of research, requiring the use of statistics, but not wholly concerned with quantitative measurement, will be the administrative and appraisal studies. These studies must be made by the Board from time to time in the States, and are intended to analyze the standards of performance and to determine the degree of administrative efficiency in the State

organizations. The Bureau of Research and Statistics, through its representatives, will participate in these administrative studies in cooperation with other bureaus of the Board.

A special division of research cooperation is being established so that the vast amount of research which is now going on and which is soon to be under way in the field of social security may be more effectively integrated. The Bureau plans to have its representatives establish and maintain close relations with other groups engaged in research—other Federal agencies, State and local public agencies, private research foundations, universities, and other research organizations interested in economic and statistical studies. If such integration can be attained, the Social Security Board may be able not only to foster research in problems relating to social security, but also to obtain the maximum advantage of such work as is done outside the Social Security Board.

Finally, a long-range research program is being developed to meet the specifications laid down by the Social Security Act. The Social Security Board, under the provisions of the Act, has "the duty of studying and making recommendations as to the most effective methods of providing economic security through social insurance, and as to legislation and matters of administrative policy concerning old-age pensions, unemployment compensation, accident compensation, and related subjects." In carrying out this duty imposed upon it by Congress, the Social Security Board will undoubtedly rely to a considerable extent upon the Bureau of Research and Statistics. Sustained studies of this type are to be made by the members of several divisions now being established. Such studies, it is hoped, may in the not too distant future have some influence upon the kind of social security legislation which will be operative in this country.

The Social Security Board is under the merit system, and, therefore, positions in the Bureau of Research and Statistics are filled through the Civil Service. It is now planned to hold a civil service examination for such positions sometime during the coming summer. Positions in a wide variety of grades, ranging from P-1 at \$2,000 to P-6 at \$5,600 minimum, will be open to the successful candidates in these coming examinations. Statisticians and economists with all types of background, but especially those with some previous work and experience in studies relating to social security, should consider making applications for these examinations.

**DIVISION OF RESEARCH, STATISTICS, AND RECORDS, FEDERAL EMERGENCY RELIEF ADMINISTRATION.**—Reports concerning relief statistics are continuing to be received from the States in simplified form. It is anticipated that these reports will continue on this simplified basis, thus maintaining general comparability with the relief statistics of the last three years. Although in certain States changes in the organization and administration of relief activities have occurred, considerable effort is being expended in attempting to obtain data from each State covering the number of families, cases and persons receiving general public assistance and the distribution of the cost of such relief by sources of funds. It has been necessary to change the de-

inition concerning the kind of relief to be reported from emergency relief from public funds to general relief from public funds thus including local poor relief but excluding categorical relief.

The Division of Research, Statistics, and Records and the Social Research Division have collaborated in preparing a schedule for the collection of relief statistics in Rural and Town Sample Areas. These areas include 322 counties selected as representative of all counties having no cities of 25,000 or more population in 34 States together with 23 towns in Massachusetts representative of all Massachusetts towns having less than 5,000 population. Data are being collected on an agency basis for all outdoor relief activities, both general and categorical, extended from public or private funds in the sample areas in January 1936. The result of this exploratory study will determine the desirability of establishing on a sample basis, a new current reporting series in the field of social statistics.

Continued efforts are being made to present statistical and descriptive summaries of the programs and activities of the Federal Emergency Relief Administration. These summaries are being published in the *Monthly Report* of the Federal Emergency Relief Administration.

DIVISION OF SOCIAL RESEARCH, WORKS PROGRESS ADMINISTRATION.—*Census of Occupations of Workers on Relief.* The Division of Social Research is assembling comprehensive data upon the occupational characteristics of workers included in the relief population. In May, 1934, an intensive study was made in 79 cities covering the personal and occupational characteristics of a cross section of the urban relief load at that time. Information was provided which has been used to indicate the degree of employability of the relief population. A final report upon this study is to be issued this summer.

In connection with the preparations for and the administration of the Works Program, two complete censuses were taken of the workers on relief, the first in March, 1935, and the second in January, 1936. These complete census counts, each covering over six million workers, have provided information upon the usual occupations of this army of workers. In March, 1935, the survey included information upon age, educational attainment, residence, color and sex, in addition to the data upon usual occupation and industry of usual employment.

The January, 1936, survey included all workers who had been certified as eligible for employment on the Works Program. This census was essentially a recount of the workers covered in March, 1935, showing the shifts that have occurred over the ten-month period since the earlier count. These series of studies taken together will provide a wealth of basic material upon the incidence of unemployment which is not available elsewhere.

*Studies of Relief and Works Program Experience in Thirteen Selected Cities.* An extension of the studies of relief accessions and separations in 13 cities throughout the year 1935 includes an examination of a cross section of the relief load as of May and October, 1935, together with a month to month summary of the status of a selected group of cases on relief between May and October, in order to describe their relief and work experience following

the withdrawal of federal relief funds. This current survey will show the successive stages whereby relief families have continued their dependent condition or have raised themselves above a relief status. Most previous studies have been limited to the relief period itself, without re-examining cases after they have left the relief rolls. A somewhat similar examination of the post-relief status of rural families is being conducted in seven states.

*Rural Relief Reporting.* A study has been undertaken in 345 counties of the public and private assistance provided in rural and town areas. It is planned to collect statistics concerning cases aided and obligations incurred for material relief by all welfare agencies, public and private, in the selected counties for selected months. It has been contemplated in the selection of sample counties that these reports may provide a basis for continuing monthly records of rural relief analogous to the urban records compiled by the U. S. Children's Bureau. Final plans for such current reports have not been completed, however, although the official relief reports of the F.E.R.A. will provide basic monthly data for the most important part of the rural relief load. Further plans are being projected in coöperation with the Social Security Board and other agencies operating through a committee of the Central Statistical Board.

A number of other studies for which final reports are contemplated to be issued this year are as follows: Inter-city Comparisons of Living Costs for 59 Cities; An Analysis of the Nature and Scope of the Relief Problem; A Study of Migrant Families; a summary report upon the Changes in the Relief Populations of 13 Selected Cities; a study of Rural Families in Combined Farming-Industrial Employment; Farm Rehabilitation Problems in the Drought Area of the West; a study of the Plantation Tenant Situation in the South. Present plans call for the assembling and summarizing of important findings of previous studies in the publication of a number of monograph reports on various topics related to relief.

Among the publications recently issued by the Division of Social Research are included the following: Research Monograph II, *Comparative Study of Rural Relief and Non-Relief Households*; the survey was made during the winter of 1933-34 in 47 counties in the major agricultural areas of the United States. Research Monograph III, *The Transient Unemployed*; this report presents an exhaustive analysis of the transient relief population, their movements, their reasons for migration, and the problems involved in the reabsorption of this group into private industrial employment. Pictograph Booklet, *Youth on Relief*, presenting some of the more basic facts relating to the characteristics of youth (persons aged 16-24) in the United States, with special reference to youth on relief; the booklet was made up primarily for the National Youth Administration and contains thirteen charts. A Research Bulletin concerning *Intensity of Relief, July 1933-June 1935* was issued as Series I, No. 18. Two Research Bulletins on *Reasons for Failure to Accept Assignments to Works Program Employment* have been released, one covering urban and rural communities of Ohio, and the other covering 13 cities.

**BUREAU OF LABOR STATISTICS, U. S. DEPARTMENT OF LABOR.**—Adjustment of the indexes of factory employment to conform with the 1933 Census of Manufactures totals is practically completed. This adjustment eliminates any bias shown in the Bureau's reporting sample between 1931 and 1933 and therefore presents a more accurate picture of the levels of employment.

In connection with the work of the Pennsylvania Railroad in electrifying its lines through a Public Works Administration loan, the Bureau of Labor Statistics has secured monthly reports on employment, pay rolls, and man-hours worked on the job, classified by States, detailed accounts as to the value of material purchased, and the man-hours of employment created in the manufacture of such materials.

Reports on the amount of production in State prisons, the value of product, and detailed information on the health and well-being of prisoners have been completed for Maryland, West Virginia, and Kentucky. It is anticipated that this study, undertaken at the request of the Prison Industries Reorganization Administration, will ultimately cover all States.

Field work on a survey of wages and hours and working conditions in the cigar industry was scheduled for completion by May 1. The study covers 15,000 employees representing 25 per cent of the total employees in the industry. Data for the two pay-roll periods are included, that is, March, 1935, when the N.R.A. code was in effect and March, 1936, in the post-code period.

The annual survey of union wage rates is scheduled to begin on May 15, 1936. This report will bring up to date the series of statistics on wages of workers bargaining collectively with their employers on working conditions. The investigation, in accordance with the usual custom, will cover important industries and occupations in various geographic locations throughout the country. While the results for 1934 and 1935 have not been published in their entirety, the computations are completed and will be supplied on request.

The Bureau of Labor Statistics is engaged upon a program of revision and expansion that covers every phase of its wholesale price reporting service. Among the more important revisions undertaken are a detailed description of the items included in the price index, an enlargement of the commodity and industry coverage, methods dealing with geographic variations in the price structure, the type and method of weighting and index computation, a more complete classification of the commodities and industries, and means of increasing the effectiveness of the published data. The Bureau has completed or is now engaged in revision of the following groups of items: Farm machinery, soap and soap products, paper and paper products, chemicals and drugs, mixed fertilizers and fertilizer materials, lumber and mill products, building board, cement, brick and tile, and other building materials.

**U. S. TARIFF COMMISSION.**—*Comparative Statistics of Imports into the United States for Consumption, by Countries, from 1931 to 1935:* Under the supervision of the United States Tariff Commission a staff of about 160 employees, taken

mainly from relief rolls, is engaged on a W.P.A. project at Richmond, Virginia, in tabulating and preparing for publication detailed statistics of imports for consumption by countries for the years 1931 to 1935 inclusive.

Beginning in 1934 detailed statistics of imports for consumption, which include imports for immediate consumption plus withdrawals from warehouse, are being reported in *Foreign Commerce and Navigation*, by countries. Prior to that time the only statistics showing imports by countries for commodities were those of general imports which include all entries into the United States whether for immediate consumption or for entry into bonded warehouses. Aside from the above indicated difference between general imports and imports for consumption the more detailed commodity classification of the latter affords a much more comprehensive basis for making year to year comparisons. The needs of the Trade Agreements Program for detailed import statistics broken down by countries emphasized this deficiency and prompted the Tariff Commission to suggest the present project.

The statistics for 1934 have already been published by the Department of Commerce in *Foreign Commerce and Navigation* and are to be included in the reports of the Commission with such minor adjustments as may be necessary to make them comparable with the figures being compiled for earlier years. With the permission of the Department of Commerce the Commission is also enabled to compile and include the preliminary figures for the statistics for 1935 in its reports in advance of their publication in *Foreign Commerce and Navigation*. The basic data from which the statistics for 1931, 1932, 1933, and 1935 are being compiled are the code sheets supplied by the Division of Customs Statistics of the Department of Commerce. While this coded material has been used constantly by the United States Tariff Commission in securing the imports of commodities from certain countries there has never been such a large or complete compilation as is now being undertaken.

Separate reports will be published for each of the 11 commodity groups shown in *Foreign Commerce and Navigation* and the classification of individual commodities will be that followed in 1931 so far as practicable. The first report to be made available, probably in April, will be for Group 7, Machinery and Vehicles, and the others will follow as rapidly as possible. It is planned to have the entire work completed by August.

Requests for this material specifying the particular group or groups wanted may be made to the Secretary of the United States Tariff Commission, Washington, D. C. Such requests will not be acknowledged but will be filled as the reports are issued.

**BUREAU OF FOREIGN AND DOMESTIC COMMERCE.**—*The balance of international payments of the United States in 1935* will be available within a few weeks. This bulletin has been prepared by the Finance Division and continues the annual series initiated in 1922. Two special studies relating to the balance of payments are in preparation. One of these will be a study of foreign investments in the United States and will present the results of the

first comprehensive survey in this virtually unexplored field. The other study will be a detailed analysis of international insurance transactions affecting the balance of payments of the United States. The latter covers the period 1919-1935.

The *Statistical Abstract of the United States, 1935* and the *Foreign Commerce Yearbook, 1935* were released in February. The *World Economic Review, 1935* will be available soon.

After a year of experimenting, the Division of Foreign Trade Statistics has perfected a statement to show from month to month the various changes and trends of our foreign trade. This statement, called *Trend of United States Foreign Trade*, is available on a subscription basis at one dollar a year. The first of these monthly statements was published in April. These statements show the total trade for the monthly period, trade by economic classes, by leading commodities, and by geographic regions. The balance of trade, quantity, and unit value (price) indexes are also shown. All data are presented on a cumulative basis, and will be compared with corresponding data for the high year 1929, the low year 1932, and the year immediately preceding the one covered by the statement.

The Division of Economic Research has been pushing ahead with its study of "Long-Term Debts." Although no date has as yet been set for the completion of the study, statisticians will be interested to know that the study will deal with the following principal topics: (1) changes in the volume of long-term indebtedness by principal classes of borrowers from 1913 to date, (2) changes in the annual interest charges on the several classes of long-term debt during this period, (3) the volume of obligations in default at different dates, (4) the comparative ages of the several classes of debt outstanding in 1933, and (5) the ownership of the evidences of debt as of a recent date.

Members of the Association who are interested in current statistics on retail sales trends should not overlook the article on the development of the Bureau's retail sales indexes which appeared in the February *Survey of Current Business*. To the coverage of independent store sales by kind of business by states announced in that article, it is hoped to add sales reports from Arkansas, Iowa, Kansas, Missouri and Nebraska during the summer months. It is anticipated that in a few weeks the first of a series of regular monthly releases will be made on manufacturers' and wholesalers' sales and collections by kinds of business. This project is being worked out by the Bureau in cooperation with the National Association of Credit Men. Tabulations on the annual "Retail Credit Survey" are progressing and the study should be available shortly.

*Market Research Sources*, a guide to information on domestic marketing, was released April 10th. *Some Sources of Current Trade Statistics* is still in preparation. Among forthcoming publications, mention should be made of the *Consumer Market Data Handbook*, *Confectionery Distribution in the United States, 1935*, *Markets for Plumbing and Heating Facilities in Residences*, additional reports on the *Consumer Use of Selected Goods and Services*, *by Income Classes*, and *World Chemical Developments, 1935*.



**FEDERAL TRADE COMMISSION.**—In January, the Commission sent to Congress its second report on the Milk Industry based upon data collected in the Philadelphia and Connecticut sheds. Printed copies became available for distribution in March (House Document No. 387, 74th Congress, 2nd Session). The report contains, among other things, an analysis of the base surplus plan as it has been employed in these two milk sheds. This shows the methods that have been employed to permit the sale at Class I prices of milk for which the producers paid the farmer at Class II and Class III prices.

Of more immediate interest to statisticians are the analyses of the sales, expenses, and profits of the milk distributors in these sheds by class of product, i.e., fluid milk, fluid cream, skim milk, butter, cheese, ice cream mix, etc., and subdivided for sales at wholesale and sales at retail. The report also contains an interesting study of the effects of different methods of cost allocations on unit delivery costs of various products, indicating that the cost of delivering milk, cream, or any other dairy product can be made either higher or lower at any particular time by merely changing the formula for allocating the delivery costs between products.

Early in March, the Commission released certain preliminary figures covering sales, costs, profits, investment, and rates of return for cotton textile companies in the first half of 1935. Earlier in the year, the Commission released similar figures for cotton spinning companies showing results separately for combed yarn, carded yarn, and combination combed and carded yarn companies in 1933 and 1934.

The Commission's Agricultural Income Inquiry is well advanced. The comprehensive character of the data called for by the Congressional Resolution, however, has rendered it difficult to obtain prompt returns. As a result, a great deal of supplementary field work is necessary in an effort to expedite the reports.

At this writing, hearings are being held on a resolution looking to the extension of the Inquiry to fresh fruits and vegetables. Hearings are also under way on a resolution directing the Commission to investigate the farm machinery industry and trade.

**INTERSTATE COMMERCE COMMISSION.**—Among the new statistical items available monthly in the reports of steam railways to the Interstate Commerce Commission are the following: (1) average price at point of purchase of coal, fuel oil, electric current, gasoline, and Diesel fuel; (2) quantities of fuel and power purchased, divided as under (1); (3) number of units of fuel and power equivalent to one net ton of coal; and (4) quantity of fuel and power consumed per yard-switching locomotive hour for steam, electric, gasoline, and Diesel locomotives separately.

**BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM.**—The text of the Annual Report of the Board of Governors of the Federal Reserve System for 1935 was released in April. The report contains an analysis of the business and credit situation in 1935 with special reference to the development of

excess reserves in that and prior years. It gives the results of a special investigation into the reserve position of individual member banks, made for the purpose of ascertaining the probable effect of an increase in reserve requirements upon the banks. A full record of policy actions taken by the Board since August 23, 1935, is published in the appendix to the report in accordance with the provision of the Banking Act of 1935 requiring the publication of such a record. The full edition of the annual report giving detailed statistics for 1935 and in some cases for earlier years has been sent to the printer and should be available before or shortly after the issuance of this JOURNAL.

FEDERAL HOME LOAN BANK BOARD.—The principal project of statistical importance since last fall in the Division of Research and Statistics is the development of a foreclosure index for metropolitan cities in the United States. This index or a chart based upon it is to be published in the April *Home Loan Review*. The March issue of the *Review* contains some new data with regard to the investments of insurance companies. A program of monthly reporting of new loans of building and loan associations is expected to be put in operation this summer. An index of the activity of building and loan associations with some breakdown as to loans for new construction and refinancing should be of considerable value from the standpoint of an early indication of revival in the home loan mortgage market.

FARM CREDIT ADMINISTRATION.—The Economics Subdivision of the Division of Finance and Research has recently begun a study of livestock financing. The chief objective of study is to determine the total debt carrying capacity of a ranch in relation to its capacity to produce income. The two principal sources which will be used in seeking an answer to this question are, first, the lending experience of the Federal land banks, the production credit associations and other agencies discounting through the Federal intermediate credit banks; second, information on a number of ranches, showing total long and short term indebtedness over a period of years, which will be studied as a basis for determining the relationship between the annual income of the ranches and their inventory values. Mr. Frank ImMasche is now on a trip through the West to gather data for this study. He will visit ranches in the Omaha, Wichita, Houston, Berkeley, and Spokane districts and will also study the records of the Federal intermediate credit banks and agricultural experiment stations throughout the area.

A study of the problems involved in financing spring wheat farmers has been started recently by the Economics Subdivision of the Division of Finance and Research. Dr. W. L. Cavert, Statistician of the Farm Credit Administration of St. Paul, has been granted a leave of absence for three months in order to take charge of the project for the Washington office. The territory included is located for the most part in the States of North Dakota, South Dakota, and Montana. The immediate objective of the study is a method of scheduling payments on extensions adjusted to annual variations in the

income of the wheat farmer. Dr. Cavert will spend the major portion of his time in the field obtaining data on income variations and in testing out the practicability of various suggested plans.

**BUREAU OF AGRICULTURAL ECONOMICS.**—A general survey of the collection, compilation, and publication of statistical series of the Bureau, including detailed study of the several kinds of problems, has been undertaken by a committee consisting of F. V. Waugh, chairman, O. C. Stine, Joseph A. Becker, F. L. Thomsen, Charles F. Sarle, and Mordecai Ezekiel.

Dr. F. L. Thomsen, for several years a professor of agricultural economics at the University of Missouri, has been appointed a principal agricultural economist in the Bureau of Agricultural Economics, and will share the administrative work of the Division of Statistical and Historical Research with Dr. Stine, in charge.

The Division of Agricultural Finance is directing a study of official county data on farm mortgages filed and released, farm land transfers and values, and farm real estate taxes, sponsored by the Works Progress Administration. Work will be done in all of the states, in about 1,000 counties, and as far as possible will cover the period since 1917.

The influence of weather and other factors on yields per acre of wheat and corn is a subject of statistical analysis recently begun under the direction of Dr. Charles F. Sarle. The project includes a historical survey and critical analysis of previous work done toward making long-range weather forecasts, and a statistical study of the planetary and lunar positions with relation to terrestrial weather, by Larry F. Page, associate meteorologist.

**NATIONAL RESOURCES COMMITTEE.**—The Science Advisory Committee to the National Resources Committee established a Committee on Population Problems on November 12, 1935. The Committee is composed as follows: Drs. E. B. Wilson, William F. Ogburn, Charles H. Judd, Warren S. Thompson, David Edsall, and L. C. Gray.

This Committee has been requested to present a report on national population problems during the summer or early fall of the present year. Dr. Frank Lorimer, Secretary of the Population Association of America, has been appointed Technical Secretary. Other technical members of the staff are: Dr. Harold F. Dorn, Professor Rupert B. Vance, Dr. Robert M. Woodbury, Professor Newton Edwards (representing the American Council on Education), Dr. Mildred Hartsough, and Miss Louise Blodgett.

**U. S. PUBLIC HEALTH SERVICE.**—Field work of the health inventory (this JOURNAL, December, 1935, p. 746) is nearing completion and the coding of schedules is under way at the field headquarters in Detroit. Cooperating with the Census of Business, the Service has sent schedules to all hospitals in the U.S.A. and will tabulate the data. A study of public health facilities has been undertaken in the 91 cities included in the health survey and in the counties in which these cities are located.

CHILDREN'S BUREAU, U. S. DEPARTMENT OF LABOR.—With the cooperation of the Subcommittee on Stillbirths of the American Public Health Association and of individual hospitals, the Children's Bureau has under way a study of stillbirth mortality in hospitals. The purpose of the study is to obtain statistical information regarding fetal and maternal conditions associated with fetal mortality, to make possible the development of a classification of causes (fetal and maternal) of stillbirths, and to further the development of a special certificate for the registration of stillbirths which may serve as a base for comparable statistics for the various States.

The study is an outgrowth of recommendations by the Subcommittee on Stillbirths of the American Public Health Association made at the annual meeting of the organization in Milwaukee, October, 1935. The report of the Subcommittee pointed out that with a falling birth rate and a very slight decline in the maternal death rate, the causes of failure to achieve a surviving child and mother become increasingly important, and that before we can hope effectively to reduce the fetal and maternal losses we must have adequate information with regard to the magnitude of the problem, the variations in prevalence, and the underlying fetal and maternal conditions associated with stillbirth mortality. (See Report of the Subcommittee on Stillbirths in the *Yearbook of the American Public Health Association*, 1935-36, pp. 244-249.)

The plan of the study and the schedule form have been considered and approved by the members of the Subcommittee on Stillbirths of the American Public Health Association, the members of the Children's Bureau Obstetric Advisory Committee, and the Chief Statistician for Vital Statistics of the Bureau of the Census.

Through the cooperation of hospitals with large obstetric services, individual reports are being obtained of all stillborn fetuses of twenty weeks or more gestation that occur in the hospitals during the next few months. The schedule sets forth a definition of a stillbirth which is that recommended by the American Public Health Association in 1908 as amended in 1913. The schedule is an adaptation of the stillbirth certificate proposed by the Subcommittee on Stillbirths of the American Public Health Association in 1935.

WOMEN'S BUREAU, U. S. DEPARTMENT OF LABOR.—At the request of 14 New England organizations, the Women's Bureau conducted a survey of possible industries and services which New England could develop to reemploy many of its jobless factory, clerical, and professional women. The survey was limited to the area in which the known volume of unemployment among women was greatest, that is, the region designated as the "major Boston marketing area."

In order to determine the character and amount of available woman power in Massachusetts, analyses were made of the United States Census figures for 1910, 1920, and 1930 on gainful employment of women, and of the occupations of unemployed women as reported by the Massachusetts Unemployment Census of January 2, 1934. Special studies were carried on in significant

specific localities, in the cotton textile communities of New Bedford and Fall River, and in the shoe manufacturing region of Brockton known as the Old Colony Area. These studies covered the extent of declining production and factory shutdowns in the shoe and textile industries, unemployment in the communities, and the extent to which cotton and shoe workers were registered at the Federal and State employment offices and on relief rolls. An attempt was also made to ascertain the mount of new industry entering these regions and the number and types of jobs opened by these industries.

After ascertaining the amount and skills of available factory-trained women, an analysis was made of the natural resources of New England. On the basis of these findings recommendations were made for new industries which private capital could successfully develop and for the products of which detailed analysis showed large potential markets existing.

Special analyses were also made of the extent of unemployment among domestic employees, clerical workers, and teachers in Boston. The numbers graduated yearly with training in the last two occupations were compared with the numbers securing employment. The tremendous oversupply of women trained in these occupations, together with the considerable number of unemployed household employees, led to a study of potential home services which could be developed to offer new vocational opportunities to girls and women. Analysis was made of the economic status of families living in suburban towns about Boston, and interviews were held with representative mothers as to needed services compatible with the family incomes. On the basis of the findings, recommendations were made for the development of three types of centrally managed household services—child-care services, household service and catering services, and a domestic engineers' household clinic.

The Women's Bureau is also publishing a study of unemployed and destitute women seeking relief. The survey was conducted in 1933 in Chicago, Cleveland, and the Twin Cities—Minneapolis and St. Paul. Incorporated also in the published report are the findings of a similar survey made at the same time in Philadelphia under the direction of Ewan Clague, in which the Women's Bureau cooperated.

Though an investigation was made of the policies and practices governing the administration of relief by the various agencies and of the types of aid given, the published report discusses mainly the results of a study of case records and interviews with unemployed lone women seeking aid. Facts are presented on the women's age, race, nativity, marital status, length of residence in city of present abode, usual occupation, last occupation, reason for unemployment, and relief granted.

**OFFICE OF EDUCATION.**—*Statistics of Public School Libraries, 1934-35*: The first sending of forms to 6,500 city and county superintendents of schools for a report on public school libraries has yielded a 54 per cent return from the cities and a 22 per cent return from the counties. The second request for reports was made in the last week in March. These reports will give the first

data collected for elementary school libraries by this office. The last collection of data for high school, college, public and society libraries was for 1929.

*College Salaries:* The March issue of *School Life*, official organ of the Office of Education, contains an article by Henry G. Badger on salaries in privately controlled colleges of 200 to 400 students, 1929-30 and 1934-35. *Circular No. 157* shows salaries paid in 51 Land-grant colleges combined for 1928-29, 1929-30, 1930-31, and 1934-35.

NEW YORK STATE DEPARTMENT OF MENTAL HYGIENE.—The statistical bureau of the Department is cooperating with the National Committee for Mental Hygiene and the United States Public Health Service in a special study of trends in mental disease in New York City. Dr. Benjamin Malzberg is completing a study of trends in mental disease in New York State with special reference to the problem of the increase in the rate of mental disease.

NATIONAL BUREAU OF ECONOMIC RESEARCH, INC.—Dr. Mitchell's annual report as Director of Research this year took the form of a survey of the sixteen years' work: *Retrospect and Prospect, 1920-1936*. Copies were distributed to both contributing-subscribers and *Bulletin* subscribers and may be obtained upon request: 1819 Broadway, New York, N. Y.

The loss of three Directors, two by death: Malcolm Rorty, and Elwood Mead; and one by resignation, Edwin F. Gay, are announced. Meanwhile George M. Harrison, President, Brotherhood of Railway and Steamship Clerks, Beardsley Ruml, Treasurer, R. H. Macy and Company, and Henry Dennison of the Dennison Manufacturing Company have been elected Directors at Large; and Winfield Riefler has been appointed to represent the American Statistical Association.

The first *Bulletin* of the 1936 series was "Income Originating in Nine Basic Industries, 1919-1934," by Simon Kuznets. This report analyzed the incomes (wages, salaries, interest, dividends, entrepreneurial withdrawals) originating in agriculture, mining, electric light and power and manufactured gas, manufacturing, contract construction, railroads, other transportation, communication, wholesale and retail trade. The other four issues included in the 1936 subscription series will be chosen from the following subjects: capital consumption, characteristics of the business cycles, 1927-1933, agriculture and business cycles, wages and hours, security and unemployment, mortgage financing.

MATHEMATICAL STATISTICS AT THE UNIVERSITY OF CHICAGO.—Beginning October 1, 1936, the University of Chicago, through its Committee on Statistics, will provide an expanded program of study in mathematical statistics. The Committee consists of Henry Schultz, Professor of Economics, Chairman; Walter Bartky, Associate Professor of Astronomy; Louis L. Thurstone, Professor of Psychology.

The instruction for which this Committee takes a coordinating responsibility is intended for those who have had the conventional courses in analyt-

ical geometry and in the differential and integral calculus as well as a good introductory course in statistics, preferably one given in the department in which the student intends to do his major work. The courses are divided into three groups:

- I. Courses in pure mathematics which are related to statistical theory.
- II. Courses in mathematical statistics which are so arranged as to constitute a sequence. These courses are intended to cover the field with sufficient intensity so that the student may gain professional competence in the modern theory of probable inference.
- III. Courses in the mathematical and statistical theories of the field of specialization of the student.

Only the second group of courses is under the immediate supervision of the Committee. The first group is given by the Department of Mathematics which has made some re-arrangement of subject matter to suit the needs of the present program. The third group of courses is given by specialists in the mathematical aspects of the social, biological, and other disciplines. These courses are under the supervision of the departments concerned.

For the two years 1936-37 and 1937-38, the courses listed under II will be:

1. Survey of Mathematical Statistics.
  - I. The Elements.—Thurstone.
  - II. Probability and Least Squares.—Bartky.
2. Correlation and Curve-Fitting.—Schultz.
3. Probability, Sampling, and Frequency Distributions.—Schultz and Bartky.
4. Numerical Processes.—Bartky.

## EDGAR SYDENSTRICKER

EDGAR SYDENSTRICKER, Scientific Director of the Milbank Memorial Fund and Consulting Statistician of the United States Public Health Service, died of a cerebral hemorrhage on March 19, 1936.

Mr. Sydenstricker was born July 15, 1881, in China, of missionary parents, the Rev. Dr. Absalom and Caroline Stulting Sydenstricker, both from West Virginia. He came to the United States in 1896. He was graduated from Washington and Lee University, Lexington, Virginia, being elected to Phi Beta Kappa. In 1902, he received the degree of M.A. from the same university. He pursued graduate work at the University of Chicago and Johns Hopkins University. After leaving college, he was principal of the high school at Onancock, Virginia, for three years. In 1905, he became editor of the *Daily Advance*, Lynchburg, Virginia, and soon thereafter also became a special writer for various newspapers and magazines.

In 1907-1908, he was a fellow in political economy at the University of Chicago. Trained as an economist, his early studies, from 1908 to 1915, were made for the United States Immigration Commission and the United States Commission on Industrial Relations. As a special investigator, he made extensive surveys of wages, working conditions, and scales of living of industrial workers, especially in industries employing large numbers of the foreign born.

In 1915, he was appointed the first statistician in the United States Public Health Service and assigned to assist Dr. B. S. Warren. Jointly they investigated the relation of economic status to the health of garment workers in New York City, and made a factual study of sickness insurance as organized and administered in European countries.

From 1916 to 1920, he collaborated with Dr. Joseph Goldberger of the United States Public Health Service in investigations of the causes of pellagra in the South, being in charge of the statistical studies designed to ascertain the relation of dietary, economic, and sanitary factors to the prevalence of this disease in cotton-mill villages. These inquiries proved extremely fruitful and aided greatly in settling once for all the question of the origin of pellagra.

Before the pellagra studies were completed, he was assigned, in the fall of 1918, to work with Dr. W. H. Frost on statistical studies of influenza. A year later, Mr. Sydenstricker was placed in charge of the statistical organization, and Dr. Frost continued to collaborate as a consultant. Other surveys and studies of influenza morbidity followed as new epidemics occurred, and a large number of papers by Sydenstricker, Frost, Collins, Britten, and other associates in the Public Health Service have been published giving a most comprehensive history of influenza from 1910 to 1930.

Continuing the method of field surveys used in the pellagra and influenza studies, Mr. Sydenstricker began in 1921 the now well-known Hagerstown-



Morbidity Survey to obtain complete and exact statistical data on factors related to sickness in a community. This survey provided the first data ever assembled on the frequency and causes of illness in an average population group.

For one year, 1923, Mr. Sydenstricker had a leave of absence from the Public Health Service to organize the Epidemiological Service of the Health Organization of the League of Nations. He established a service there which has been continued ever since under Dr. F. G. Boudreau.

In 1925, he became research consultant to the Milbank Memorial Fund. In 1928, he joined the staff as Director of Research and became the administrative head of this Foundation in April, 1935, with the title of Scientific Director. Throughout this period he acted as consultant for the United States Public Health Service.

The broad scope of the public health studies which he initiated or directed in recent years may be indicated by mentioning a few: analyses of health examinations made by the Life Extension Institute to determine the prevalence of physical impairments; special health examinations of a rural population of 1,000 persons; studies of the availability and use of medical and public health facilities; studies of the fertility of different social classes in communities of varying size and of the trends of fertility. In 1935, to answer the much debated question of whether the health of industrial groups was being affected by the depression, he planned a series of surveys to study morbidity and mortality in families of industrial workers in ten communities.

In 1934-1935, he was associated with President Roosevelt's Committee on Economic Security and directed its studies on "Risks to Economic Security Arising Out of Ill Health." Largely as a result of his work with this Committee, a plan for an expanded Federal program of public health and disease prevention was developed.

Mr. Sydenstricker was the author of numerous books, monographs, and reports on various subjects in the field of economics and public health. Among his more important contributions are the following:

#### BOOKS AND MONOGRAPHS

- Brief History of Taxation in Virginia (1915)
- Collective Bargaining in Anthracite Coal Industry (1916)
- Conditions of Labor in the United States (with W. S. Lauck) (1917)
- Hagerstown Morbidity Studies (Collected Papers) (1926-1930)
- Health and Environment (1933)

#### REPORTS AND PAPERS

- Study of the Relation of Diet to Pellagra Incidence (Co-authors: Joseph Goldberger and G. A. Wheeler) (1920)
- Pellagra Incidence in Relation to Sex, Age, Season, Occupation, and "Disabling Sickness" in Seven Cotton Mill Villages in South Carolina During 1916 (Co-authors: Joseph Goldberger and G. A. Wheeler) (1920)
- The Relation of Factors of a Sanitary Character to Pellagra Incidence (Co-authors: Joseph Goldberger and G. A. Wheeler) (1920)

- Relation of Family Income and Other Economic Factors to Pellagra Incidence (Co-authors: Joseph Goldberger and G. A. Wheeler) (1920)
- Method of Classifying Families According to Incomes in Studies of Disease Prevalence (Co-author: Willford I. King) (1920)
- Variations in Case Fatality During the Influenza Epidemic of 1918 (1921)
- Heights and Weights of School Children (Co-authors: Taliaferro Clark and Selwyn D. Collins) (1922)
- Weight and Height as an Index of Nutrition (Co-authors: Taliaferro Clark and Selwyn D. Collins) (1924)
- Disabling Sickness in Cotton Mill Communities of South Carolina in 1917 (Co-author: Dorothy G. Wiehl) (1924)
- Measurement of the Results of Public Health Work, An Introductory Discussion (1926)
- Declining Death Rate from Tuberculosis (1927)
- Tuberculosis Among Relatively Neglected Groups (1929)
- Trend of Tuberculosis Mortality in Rural and Urban Areas (1929)
- Physical Impairments of Adult Life (Co-author: Rollo H. Britten) (1930)
- Physical Impairments and Occupational Class (Co-author: Rollo H. Britten) (1930)
- Differential Fertility According to Social Class (Co-author: Frank W. Notestein) (1930)
- Study of the Fertility of Native White Women in a Rural Area in Western New York (1932)
- Prevalence of Tuberculosis Infection in a Rural Community in New York State (Co-author: Jean Downes) (1933)
- Sickness and the New Poor (1934)
- How Unemployment Affects Illness and Hospital Care (Co-author: G. St. J. Perrott) (1934)
- Health in the New Deal (1934)
- The Changing Concept of Public Health (1935)
- Medical Practice and Public Needs (1934)
- Health Insurance and the Public Health (1935)

In 1917, he became a member of the American Statistical Association, and, in 1922 was honored by election as a Fellow. Between that time and the date of his death, he served on various committees of the Association, and was appointed as a representative of the American Statistical Association on the Social Science Research Council for the period 1931 to 1934. He was elected Counsellor in 1923 and served as a member of the Board of Directors from 1932 to 1934. In 1933, he was appointed Associate Editor, and retained this position for the remainder of his life. His keenness of mind and well balanced judgment always made his confrères value highly his advice and counsel.

In his relations with subordinates, he was patient, courteous, and considerate, and, in his dealings with others, he was a model of diplomacy. His personality was characterized by an unusual degree of calmness, fairness, and geniality.

He was gifted with the rare combination of imagination and vision in his approach to social problems and of ability to weigh critically and dis-

passionately the facts involved. All his scientific work has been marked by his determination to get at the fundamentals of a problem. If data were not available, he planned to collect them, no matter how arduous or time-consuming an investigation was required. For this reason, most of his studies have been based upon original material and each has made a unique contribution to our basic knowledge concerning the conditions in this country which affect public health.

In brief, Edgar Sydenstricker came as near as a human being can to being the perfect scientist. He always studied his problem till he knew exactly what he was trying to find out. He emphasized thoroughness, but kept a true perspective and hence did not unduly concern himself with irrelevant trifles. He never jumped at conclusions, for he did not allow himself to be influenced by preconceptions or prejudice, and he always weighed the evidence with unusual care. He was a statesman in public health, and all of society was within the field of his vision.

WILLFORD I. KING

New York University  
April 24, 1936

## NEW MEMBERS

- Abrahams, Pauline, 1853-65th Street, Brooklyn, New York
- Armstrong, Robert H., Partner, Armstrong & Armstrong, 485 Madison Avenue, New York City
- Bacon, Marvin A., Instructor in Economics, Vanderbilt University, Box 34, Nashville, Tennessee
- Bransford, Thomas L., Research Assistant, U. S. Civil Service Commission, Research Division, Room 262, 7th and F Streets, N. W., Washington, D. C.
- Brenner, O. L., Economic Statistician, Southern Bell Telephone and Telegraph Company, Box 2211, Atlanta, Georgia
- Butterworth, Virginia, Investigator, Connecticut Department of Labor, State Office Building, Hartford, Connecticut
- Cohen, Leon I., Statistician, Fellaurs Davis and Company, 52 Broadway, New York City
- Cook, A. Clinton, Assistant Marketing Specialist, Agricultural Adjustment Administration, South Agricultural Building, Washington, D. C.
- DiMario, Marie, Assistant Supervisor of District Health Records, Department of Health, 125 Worth Street, New York City
- Friedman, Milton, Associate Economist, Consumption Research Unit, National Resources Committee, c/o National Resources Committee, Room 4020 Interior Building, Washington, D. C.
- Griffith, Sanford, Partner, Thomas & Griffith, 44 Wall Street, New York City
- Gussman, George, Statistical Clerk, Bureau of Labor Statistics, U. S. Department of Labor, Washington, D. C.
- Hackman, Dr. Abe, Statistical Analyst, New York State Temporary Emergency Relief Administration, 79 Madison Avenue, New York City
- Hart, John N., Assistant, Department of Economics, College of Commerce, Ohio State University, Columbus, Ohio
- Herzig, Leonard S., Partner, Sartorius & Smith, 61 Broadway, New York City
- Holbrook, Russell S., Director of Research, St. Louis Globe-Democrat, Globe-Democrat Publishing Company, 1133 Franklin Avenue, St. Louis, Missouri
- Juran, J. M., Chief of Inspection Control Division, Western Electric Company, Hawthorne Station, Chicago, Illinois
- Kalb, John, Security Analyst, D. M. Minton and Company, 111 Broadway, New York City
- Lane, Paul V., Research Engineer, California Taxpayer's Association, 775 Subway Terminal Building, Los Angeles, California
- Lawrence, Charles B., Jr., Chief, Audit and Control Section, Works Progress Administration, Washington Auditorium, 19th and New York Avenue, N. W., Washington, D. C.
- Lazarsfeld, Dr. Paul F., Research Director, University of Newark, Rector Street, Newark, New Jersey
- Lutz, Warren H., Statistical Analyst and Technical Assistant, Philadelphia Electric Company, 1000 Chestnut Street, Philadelphia, Pennsylvania
- McElroy, Joseph P., Clark, Dodge and Company, 61 Wall Street, New York City

- McNeely, Henry E., Accountant, The R. C. Mahon Company, 8650 Mt. Elliott Avenue, Detroit, Michigan
- Mitchell, John W., Research Assistant, Works Progress Administration, 1734 New York Avenue, N. W., Washington, D. C.
- Naigles, Myer H., Assistant Financial Statistician, Securities and Exchange Commission, Research Division, 1778 Pennsylvania Avenue, N. W., Washington, D. C.
- Price, Hallie K., Director of Research and Statistics, South Carolina State Department of Public Welfare, 1246 Main Street, Columbia, South Carolina
- Roslow, Dr. Sydney, Psychologist, Robert Louis Stevenson School, 306 West 88th Street, New York City
- Rousitsky, Peter M., Associate Economist, Central Statistical Board, 7028 Commerce Building, Washington, D. C.
- Schrader, William Aldrete Benton, Graduate Scholar in Psychology, Ohio State University, Columbus, Ohio
- Thomas, Verna H., Statistical and Bond Clerk, Ohio State Teachers Retirement System, Columbus, Ohio
- Willis, George H., Assistant, Foreign Information Division, Federal Reserve Bank of New York, 33 Liberty Street, New York City
- Wittman, Charles H., National Bureau of Economic Research, 1819 Broadway, New York City

## REVIEWS

*Einführung in die mathematische Statistik*, by Oskar N. Anderson. Vienna: Julius Springer, 1935. v, 314 pp. 23.60 marks.

This fresh and interesting book on mathematical statistics was written for statisticians, not for mathematicians, by a statistician who considers mathematics as a tool. The author emphasizes this point of view in his introduction, which opens with quotations bearing on this point from Charlier, R. A. Fisher, and Tschuprow, that from Tschuprow being *Statistik spielende Mathematiker können nur durch mathematisch ausgerüstete Statistiker überwunden werden*. Various definitions of mathematical statistics are given in the introductory chapter, but the definition towards which the author inclines is "that part of theoretical statistics which is in close contact with the theory of probability and which can almost be called applied probability theory." Under this definition actuarial mathematics could be included, but this subject is considered as too special and really a science by itself.

The table of contents of the book reads very much like that of other works on mathematical statistics. Considerable space in the beginning is devoted to the theory of probabilities. A very readable discussion of the various definitions of probability leads up to the author's own "working definition," as follows: The probability of an attribute in the field of a statistical aggregate is its relative frequency within an aggregate of higher order from which the first aggregate was derived; or, more specially, the probability of an attribute in a sample is its relative frequency in the population from which the sample was drawn. This idea of an aggregate of higher order is a marked characteristic and colors the language throughout the book. As distinguished from the usual notion of "population" with its infinite content, the aggregate of higher order may be finite or infinite.

Professor Anderson suggests six subdivisions of the theory of statistics which a comprehensive book should cover:

1. The study of measures of central tendency and other so-called statistical parameters used for describing a statistical aggregate. This, of course, includes the discussion of averages, measures of dispersion, moments, measures of correlation, index numbers, and so on. Much of this should appear in the more elementary books which the reader of Professor Anderson's book is supposed to have read previously.

2. The study of inferences that can be drawn respecting the average characteristics of an aggregate of lower order (perhaps a random sample) from a knowledge of the corresponding characteristics of an aggregate of higher order (the population from which the sample was drawn).

3. The study of inferences that may be drawn concerning the unknown parameters of an aggregate of higher order from a study of an aggregate of lower order. This part covers the topics of random sampling, "goodness of fit" tests, and Baye's theorem. Professor Anderson's discussion of Baye's theorem is remarkably clear and reasonable.

4. The study of temporal and spatial stability of aggregates of higher orders. A discussion of Pearson's or Charlier's system of curves, Thiele's semi-invariants, and Hermite's polynomials usually would come under this heading, but Professor Anderson touches them lightly for he is more interested in the somewhat unstable aggregates met by the sociologist or economist than in the relatively stable aggregates in biological statistics.

5. The study of aggregates or universes which are unstable in time or space. This covers in part the topics of time series, interpolation, combinations of observations, and the investigation of the existence of stable components of an unstable aggregate.

6. The study of statistical methods necessary to the establishment of relations of cause and effect. This frontier subdivision of statistics is awaiting workers. The attempt to adapt the theory of correlation to use in this foreign field has led to much confusion.

The above six subdivisions of statistical theory are suggested as the content of an extensive and comprehensive treatise. Since the work under review is an introduction into the field, the author selects from this outline those topics which "will give the reader a closer contact with the spirit and concepts of the science." Then, he attempts to make clear to the student that mathematical statistics enables one to secure richer and more trustworthy information from given data than is possible by the so-called elementary methods. Again, mathematical statistics serves another very important function, that of a brake in connection with the wide-reaching conclusions that are often drawn from data meagre in amount and quality. This "Hemmschuh" function is generally unnoticed by enemies of mathematics in statistics. Other influences which dictated the selection of topics were pedagogical and a regard for the mathematical attainments of the reader who is supposed to be pretty well up on his algebra and has a smattering of calculus. In the United States the book would be considered as rather mathematical.

It turns out that the book covers the first three of the subdivisions rather adequately. To do as well for the last three would have doubled the size of the book, so the author was content with discussions in broad outlines with copious footnotes pointing out references in the literature for details or for further study. The footnotes throughout the volume, both explanatory and bibliographical, are a feature and include a well selected bibliography international in scope.

A. R. CRATHORNE

University of Illinois

*Elements of Statistics with Applications to Economic Data*, by Harold T. Davis and W. F. C. Nelson. Bloomington, Indiana: The Principia Press, Inc. 1935. xi, 424 pp.

There appear to be divergent tendencies among recent textbooks in statistics. One is toward the development in laymen of an appreciation for statistics and an understanding of the rudiments of its methods without a detailed knowledge of mathematics. The other, a manifestation of the de-

mand for better trained practitioners in the field, is toward the provision of a comprehensive background based on rigid mathematics.

This book falls into the second class. The recommendations of the Social Science Research Council Committee on the place of collegiate mathematics in the social sciences have provided the general guides for Professors Davis and Nelson. To study the text effectively a student should have had as a minimum the ordinary college mathematics courses through integral calculus. With judicious elimination the authors suggest that the work can be used by students with less training in mathematics.

The volume is divided into twelve comprehensive chapters: Preliminary Analysis of Statistical Data, Graphical Analysis of Data—Elementary Curve Fitting, Methods of Averaging, Index Numbers, Analysis of Time Series, Analysis of Artificial Data—Probability, Binomial Frequency Distributions, Normal Frequency Curve—Problems in Sampling, Curve Fitting, Elements of Correlation, Multiple and Partial Correlation, and Types of Statistical Series.

That the text covers much ground is manifest in the first chapter. As an introduction to it a history of statistics is given in which in their proper places are mentioned many men whose names do not usually appear in beginning texts: Quetelet, Bernoulli, de Moivre, Euler, LaGrange, Lexis, Walras, Pareto, etc. This introduction makes it clear that the emphasis is that of mathematical and statistical economics. In this same chapter the student is introduced to collection of statistical data, classification, frequency distributions and the binomial theorem. In general the subjects treated are similar to those of the orthodox statistics text. Six kinds of averages are presented: (1) arithmetic mean, (2) quadratic mean, (3) median, (4) mode, (5) geometric mean, and (6) harmonic mean. Three common methods of measuring dispersion are considered: (1) standard deviation, (2) average deviation, and (3) position measures, such as quartiles and deciles. Index numbers are treated "only from the standpoint of the mathematical formula" (p. 114). Time series analysis treats of trends, seasonals, and cycles and, in addition to a general discussion of methods, illustrates short-cut computation devices.

In view of its intended purposes, the first five chapters meet the requirements of the book but are less well done from the point of view of the student than the last seven chapters. Even though a student may have the necessary mathematical prerequisites, these early chapters take too much for granted or depend upon the instructor too greatly. Occasionally, terminology not subsequently used is introduced, and interpretation, so badly needed by beginning students, is not always adequately given, though some sort of an illustration is usually presented.

The superiority of the last seven chapters may be due to the increased need for mathematical treatment in dealing with probability, frequency distributions, sampling, curve fitting, correlation and statistical series—Bernoulli, Lexis, and Poisson. Developments are complete, and description is clear and well done. Even in Chapter XII, which the authors suggest as one of the first sections to eliminate, the treatment is not too involved and is well illustrated.



It is the opinion of this reviewer that Davis and Nelson have provided the best of the mathematical statistics textbooks. At the end of their last chapter the authors say, "The reader is now upon the threshold of modern mathematical statistics and the problems are both numerous and difficult" (p. 333). The truth of this statement cannot be gainsaid, but a student who has passed a course in which this book has been well used will have a much better right and basis to proceed than most students who have "had statistics."

The format and type face combine to produce a very readable text. This reviewer has painstakingly gone through many, but by no means all, of the mathematical and arithmetical developments and has found very few needs for correction. As it is to be expected, there are occasional statements with which one can differ. For instance, "Study of these graphs will enable students to approximate roughly a correlation coefficient from a scatter diagram" (p. 261). It has been the reviewer's experience that considerable practise is necessary, because of the effect of scales, before even close approximations can be made to a correlation coefficient by this device, and that college students do well merely to recognize the presence of correlation from a scatter of observations. Occasionally necessary or helpful qualifying words or statements are not made. In one case a definition is not correct as it is described symbolically (definition of the quadratic mean and its formula, on page 73).

The book has a number of admirable features. Appendix I gives biographical notes on a number of mathematical economists: Cournot, Jevons, Walras, Pareto, and Edgeworth. In Appendix II, there is provided a short review of computation aids, the law of exponents, logarithms, the number "e," and logarithmic series. Appendix III is introduced by a note on interpolation which is followed by tables: five place logarithms,  $y = e^x$ ,  $y = e^{-x}$ , squares and square roots from 0 to 999, reciprocals,  $y = 1/\sqrt{2\pi}e^{-1/2}$ , area under the normal curve, values of Pearsonian probability,  $P$ , and coefficients for fitting straight lines and parabolas. At the end of each section many student problems are given with necessary data provided. Answers appear at the end of the book.

This text is excellently suited for use in institutions where attempts are being made to prepare able practitioners in a rapidly growing field and where students have been well prepared in basic courses.

LESTER S. KELLOGG

The Ohio State University

*The Use of Statistical Techniques in Certain Problems of Market Research*, by Theodore Henry Brown. Boston: Harvard University, Business Research Studies—No. 12. 1935. iv, 24 pp. \$1.00.

This pamphlet consists (1) of solutions of four marketing problems, whose mathematical types are standard in the theory of large samples, (2) a table showing the size of sample to yield accuracy of three times the standard

deviation for values ranging from .1 to 40, (3) notes on sampling problems, and (4) mathematical appendixes. Typical of the problems is one in which it is desired to know whether differences in percentage frequencies of consumer preferences for particular toilet soaps are significant.

The aim of the pamphlet, according to the author, was to provide business organizations with statistical techniques for handling their problems and to facilitate a wider test of the practical applications of these procedures. To a limited extent such aim is accomplished, but it is deeply to be regretted that the author has made several careless or incorrect statements of sampling theory and that he has given no discussion of small versus large samples. Illustrative of the former point, we find him stating on page 16, "Experience shows that for practical purposes it apparently is safe to say that three standard deviations will be exceeded only once in 100 trials," whereas tables of the probability function give the figure of 3 in 1,000. In another instance, p. 8, he writes (the reviewer's italics): "The method of calculating this value of  $\sigma$ , is derived directly from the *definition*, which states that the standard deviation is equal to the square root of the average square of the given values *corrected* by the square of the average of the values." Moreover, the mathematician will be somewhat amused in reading the passage on page 7, "The data which are gathered by this process vary from observation to observation. They are known, consequently, as variables." With respect to the issue of small and large samples, the author says nothing but lists in his table of size of sample, values of  $n$  considerably less than one hundred, a commonly accepted point of demarcation. Nevertheless, the study should prove of value to organizations meeting the types of problems considered.

CHARLES F. ROOS

Cowles Commission for Research in Economics

*The Application of Statistical Methods to Industrial Standardization and Quality Control*, by E. S. Pearson. London: British Standards Institution, Publication No. 600. 1935. 161 pp. 5s. 6d.

Largely through the work of Dr. W. A. Shewhart, of the Research Laboratories of the Bell Telephone Company, there has resulted within the last few years a marked increase in interest among representatives of certain manufacturing industries, here and in England, in the application of statistical methods to problems of standardization and specification. This publication is a part of a program initiated by Shewhart, E. S. Pearson, B. H. Wilsdon, and others at a conference held in 1932 under the sponsorship of the British Standards Institution.

The book is essentially a review of the simpler statistical methods applicable to the problems of standardization and specification of quality of manufactured products. With a minimum of technical terminology the author has clearly and systematically shown why statistical technique is essential in the solution of many industrial problems of control of quality and has discussed the type of assistance it can give. It is shown that the actual framing

of specifications depends, in many cases, upon preliminary investigations along statistical lines. Considerable emphasis is placed on the method of sampling as a basis for securing conformity to a specification, by which the consumer can be assured of quality on the one hand, and the producer warned against lack of control of quality on the other. "Fiducial limits" rather than the traditional "probable error" are used for expressing the accuracy of the information deduced from the sample. In situations where it is not economically feasible for the consumer to test a sufficient number of units to give him information of the desired accuracy regarding the consignment, the problem arises of devising a method of assessing the level of the control of quality during routine production, to be furnished by the producer under a guarantee or mark system. Methods of collection and arrangement of test records on control charts are considered for handling this type of problem. The author has limited his treatment to the case of one statistical variable and has only briefly mentioned the possible value of the correlation or regression method in specification and control problems.

The methods and discussions are thoroughly illustrated by several sets of data from various principal industries. The book is well equipped with tables, figures, and folded charts and contains seven appendices of a slightly more technical nature. Because of the simple and systematic form in which Professor Pearson has presented the material in this book, it should arouse further interest in the application of statistical methods on the part of manufacturers and others concerned with problems of specification and standardization. More specifically, it should prove useful as a guide for the non-mathematical technician who must sooner or later learn to recognize, among the various problems that arise in his immediate domain, those which call for treatment by statistical methods.

S. S. WILKS

Princeton University

*Manuale di Statistica*, by Felice Vinci. Bologna: Nicola Zanichelli. 1934.

Vol. I, vii, 230 pp.; Vol. II, 302 pp. Lire 25 each.

*Statistica*, by Filippo Virgili. Milano: Ulrico Hoepli. 1934. xii, 266 pp.

Felice Vinci offers in his two volumes a comprehensive presentation of methods of statistical analysis in its application to the study of social phenomena. Theoretical discussion and examples of actual computations are combined in such a way as to give the reader not only fundamental understanding but also practical guidance in empirical work.

The First Part (Vol. I) is devoted to problems of tabulation and graphic presentation of primary data, to discussion of characteristic constants and a very useful, because careful and explicit, description of various methods of empirical curve fitting. The Second Part (Vol. II) contains a rather minute analysis of a very complete array of different theoretical distribution schemes. Part Three (Vol. II) is entitled: "Relation Between Groups of

Observations." The somewhat heterogeneous contents of these chapters include the discussion of such subjects as index numbers, mortality tables, time series analysis, correlation, and, finally, three short but very suggestive studies in economic dynamics.

Built on rather conservative, one might say classical, lines, the work does not contain any reference to the recent developments in the theory of sampling.

Professor Vinci carefully avoids the use of infinitesimal calculus. Thus the majority of his mathematical proofs is given in a somewhat lengthy form of algebraic developments. In a few instances, where this method ceases to be useful, the argument is interrupted and final formulae are presented without formal proof but with appropriate interpretations.

Although every opportunity is used by the author to derive the empirical examples from the realm of economic phenomena, a very large part of his factual material is still drawn from the traditional fields of biometrics and demography. Numerous bibliographical notes and an extensive index make of Felice Vinci's *Manuale* a valuable reference book.

Filippo Virgili's *Statistica* is a very elementary introduction expressively written along the lines of the "official program" for use in technical schools. A large part of this diminutive volume is given to a discussion of the nature of statistical science and of the general principles of induction. In the following methodological chapters the space is equally divided between an exposition of elementary principles of tabulation and classification of primary data and explanation of fundamental properties of the main statistical constants. The rest of the book is devoted to what might be called an abbreviated statistical abstract, a quantitative description of the economic, social, and cultural life of Italy.

WASSILY LEONTIEF

Harvard University

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*Public Intelligence*, A Study of the Attitudes and Opinions of Voters, by Seba Eldridge, Lawrence, Kansas: University of Kansas. Humanistic Studies. Vol. V, No. 1. 1935. 101 pp. \$1.00.

Twelve hundred fifty questionnaires on the League of Nations, the tariff, and compulsory arbitration of industrial disputes were circulated, chiefly in Kansas, during the years 1924-1927. The questionnaire was in the form of a true-false test, and scores of political intelligence were assigned on the basis of the agreement of the voters with the consensus of informed opinion on the issues covered. The data were subjected to detailed and competent statistical analysis, the nature of which will be apparent from a brief summary of some of the principal results.

"On a true-false test assumed to represent a fair measure of political intelligence, a mean score of 21.4 (on the basis of 100 as perfect) was obtained by the group of 1250 considered as a whole; 24.4 per cent of this group had scores of 50 or above (the assumed index of civic competency); while 20.4

per cent received negative scores, indicating that voters had to this extent been conditioned to a larger number of erroneous than of valid opinions on public questions" (p. 88). Although there is no pretense that the sample is either adequate or representative for the country as a whole, there is considerable probability of its representativeness for each of the occupational groups included. The fact that professional workers are greatly over-represented, whereas farmers and housewives are under-represented, suggests, however, that a representative sample would show very much worse results than those indicated above. Professional people averaged highest; farmers, non-manual workers, and business proprietors lowest. Housewives and manual workers occupied an intermediate position. No important differences on the basis of sex were observed. Schooling above high school is positively correlated with political intelligence. Reading of daily papers is of doubtful significance, but political intelligence is directly and significantly associated with the number of magazines read regularly, especially when the magazines are the better liberal journals. Multiple and partial correlations show magazine reading to be second in significance only to college education among the measurable factors. Age is found to be of no significance when other factors are held constant. Spatial, occupational, and partisan mobility are found to be positively associated with political intelligence.

The general significance of this excellent monograph lies perhaps chiefly in the methodological transition which it represents and which has been carried still further in the recent work of Thurstone and Gosnell. These hundred pages are of more scientific relevance and value than the last dozen volumes I have seen on the same subject by conventional political scientists. Especially praiseworthy is the author's detailed account of his methods and his recognition of the limitations of his study.

GEORGE A. LUNDBERG

Columbia University

*Analisi di Statistica Economica*, by Libero Lenti. Milan: Casa Editrice Aracne. 1934. 166 pp. Lire 15.

As the author points out in the preface, the volume under review is primarily descriptive in character. Its main purpose is to present a discussion of some of the significant statistical sources, materials, and techniques which may be used to advantage in a study of Italy's economic life during the post-War period. The materials contained in his book, Dr. Lenti suggests, will probably be used by him at some later date as a basis for a more comprehensive and detailed investigation in this field.

The volume begins with a brief introductory discussion of the techniques evolved for the description and measurement of economic phenomena and with a short critical analysis of some of the better known methods of economic diagnosis and of economic forecasting. This analysis is followed by

the presentation of actual statistical materials on some of the major phases of Italy's post-War economic activity. Throughout this presentation the author interpolates detailed methodological discussions ranging from a critical appraisal of statistical sources to an analysis of the proper formulae and methods of weighting employed in the computation of some of the indexes which he presents in the volume. Special chapters are devoted to the treatment of such topics as the construction of indexes of Italian stock exchange prices, of Italian clearing house operations, and of the trading volume on Italian stock exchanges, and to the statistical measurement of money market rates, of the activity of Italian corporate enterprises, of wholesale and retail prices, of bankruptcies, of the volume of railroad and building operations, and of unemployment.

Although from the point of view of statistical technique Dr. Lenti's book offers little that is novel to the trained statistician, the materials on some of the more important phases of Italy's economic life and the accompanying methodological discussions which the volume contains are interesting and instructive. Even though Dr. Lenti's principal objective in writing this book was admittedly that of presenting, mainly for the benefit of Italian economists, an elaboration and methodological interpretation of significant statistical data, this reviewer feels that some discussion at least of the light which these data throw upon Italy's economic position during the depression and upon the economic condition of her people would have been of interest both to the general reader and to the trained economist for whom the volume is primarily intended and should therefore not have been entirely omitted.

WILLIAM G. WELK

The College of St. Thomas

*New Numbers*, by F. Emerson Andrews. New York: Harcourt, Brace and Company. 1935. 168 pp. \$2.00.

My task as a reviewer is neither to defend the system in existence nor to be an exponent of a new system. The author evidently is not a mathematician. He is an enthusiastic supporter for the number 12 as the base of our number system. My job is to determine whether the author has fairly and accurately stated his case.

The title is misleading. The numbers are not new. The idea is not new. Most texts on algebra that give more than the elements of algebra contain chapters on expressing numbers with a base different from 10. And then on p. 15 the author states, "Yet, because this idea questions the habitual, it has very seldom been tried, even among mathematicians." At the bottom of p. 32 the author states "There is no way of packing ten eggs . . . except in two rows of five eggs each . . . either way the package is long and unhandy." It hardly seems possible that the author has not seen the carton

now used for handling eggs—two rows of six eggs. No doubt he does not approve of this package which is in well-nigh universal use.

On p. 33, the author says "We divided time almost happily." Is it possible that in his enthusiasm over revising our number system that he has not heard of the dissatisfaction with our calendar?

The author's wording is not accurate. As an example, on p. 46, "Table I lists the actual factors . . . and gives the number of factors." This is not true. From Table I by counting one can determine the number of factors, but the table does not give the number of factors. This may seem to be quibbling, but the example is just one instance of the author's inability to state his ideas clearly and accurately. I pick this example, for it is simple and obvious. Again, on p. 45: "From the viewpoint of ease of calculation, it would be stupid to select for our base any number which does not appear frequently in such computations as we have examined; it would not be apt to come out in round numbers often enough." Is it clear what is meant by the last *it*? The cited examples are typical of the poor quality of the expression throughout the book.

The book is crowded with bald assertions for which no proof is attempted. For example, p. 49: "An examination of 6 reveals real possibilities. It is at least far better than our present number base." "To learn 12 tables when our number system is based on 10 was . . . an open acknowledgment of the superiority of 12."

P. 58: "In the system of 10, 33 of the totals end in zero. In the system of 12, 40 of the totals end in zero—another advantage in practical brevity for the new radix." This statement contains two errors: 33 and 40 should be replaced by 32 and 39. The author seems lacking in even the elements of logical thinking. For example, on p. 48, after some rambling statements he inserts a *therefore*, intimating that he has proved something. The statement just quoted from p. 58 might with equal logic read as follows: In the system of 10, 9 of the totals end in 5; in the system of 12, 3 of the totals end in 5—another advantage in practical brevity for the old radix.

The argument on p. 69 is not fair. In solution A the first half is done with a base 10; the second half is a mixture of bases 10 and 12. Solution B is done wholly with a base 12. In the numerical example on p. 74 the two bases are again mixed in a similar way in one solution—and the second solution is done wholly with a base 12.

The author undoubtedly is not a mathematician and is not acquainted with the accepted language used in the most elementary high school algebra. Otherwise he would not use the expression, "The behavior of exponents when they themselves are raised to powers." The accepted wording is "power of a power."

I do not find anything new in the book—not even a new way to make errors—not even a new way to reason illogically.

W. V. LOVITT

Colorado College

*On Economic Planning*, Papers delivered at the Regional Study Conference of the International Industrial Relations Institute (IRI), New York, November 23-27, 1934. Edited, with an Introduction, by Mary van Kleeck, and Mary L. Fledderus. New York: Covici Friede. 1935. xiv, 275 pp. \$3.00.

This book is alleged to "represent the first serious attempt to make a comprehensive study of the subject of social economic planning." The Conference, of educators, technicians, economists, engineers, and public officials, was called to consider this theme: "What kind of economic planning can end unemployment, establish security, and raise standards of living in proportion to productive capacity?" The answer in this book is that it is possible to have economic planning in a fascist society, in a communist society, or in a democracy. Very largely in a praiseworthy attitude of impartiality, the various papers discuss the different kinds of problems economic planning has faced in these various types of social organization. It is true that the discussion of the possibilities of economic planning under fascism so far as they point towards general welfare receive little sympathy; and it is true that the description of the theory of the economic planning of Russian communism is presented in such a manner as to ignore the costs involved in the various forms of liquidation which have taken place there. But taken as a whole, the book represents the view that economic planning is a term which can be used synonymously with governmental intervention and to the extent that there is governmental intervention there is economic planning. Thus it is not the conventional idea that economic planning is an alternative form of social organization, of which we can take none or all.

Such a conception is clearly brought out in the discussion by Harold Butler, director, International Labor Organization, on "Economic Planning and Labor Legislation," chapter ii of the book, where he says: "In Great Britain, payrolls fell to a relatively moderate extent, and the money volume of retail sales was sustained. There is a reasonable supposition that the heavy falls (in retail sales and payrolls) in Germany and the United States were correspondingly responsible for the movement of production in those countries. One can scarcely doubt that the form of distribution of the purchasing power of a country, such as is involved in unemployment benefits and assistance, workmen's compensation, old age pensions, and other forms of social insurance, played a tremendous part in maintaining an even keel of economic activity." Again, he says: "It was at a very early stage of industrial history that social and humanitarian considerations led governments to impose these limitations on the so-called pure process of economic readjustment. That ideal society in which conditions of labor were determined exclusively by the forces of supply and demand has really never existed." Finally, he says, "it is quite obvious from what has been said that economic planning and labor legislation are not conditioned, in any inevitable fashion, by any special type of political institution for their realization."

Valerian V. Ossinsky, Vice-Chairman, State Planning Commission (Gos-



plan); and director, Central Administration of National Economic Accounting of the Union of Soviet Socialist Republics, discloses a liberalism which is quite unexpected. Lenin's belief that Russia could attain socialism without necessarily carrying the class-war into capitalistic Europe or America, and also the fact that the material aspects of soviet planning have been so amazingly successful may be considered to account for this new liberalism. Engaged as he is in the practical operation of a program to bring about production, his whole attitude towards the Marxian formulas seems to be not one of the doctrinaire, but a sort of presumption in favor of the ideology that the aim (which is their primary aim) of a planned economy may best operate if the society is made classless because society can then be functional. This is a far cry from Marx and the dictatorship of the proletariat.

In all these respects, Ossinsky, the practical worker in a socialistic state, is in striking contrast with the doctrinaire Alfons Goldschmidt, whose discussion constitutes the opening chapter of the book. Here we have the old formulas, decorated with a bewildering set of "laws" of which Dr. Goldschmidt is an incorrigible formulator. If stripped of his digressions into the formulation of cryptic "laws" of this and that, Dr. Goldschmidt's theoretical discussion of economic planning is a searching one. But in spite of his critical review of the history of utopias, he is himself a sort of utopian Marxist. Dr. Goldschmidt thinks Russia is an industrial democracy. Perhaps it is, but if it is, it is not Marxian socialism but Fabian socialism.

Walter N. Polakov discusses in chapter xiv the unused productive and technical capacity in the United States, using the figures of the National Survey of Potential Product Capacity. This last study was made, says Dr. Polakov, with a view to determining what consumer goods and services could be expected if production were directed toward the satisfaction of needs and reasonable wants of the population and if it were limited by physical factors only. The figures thus studied showed that in 1929 there could have been produced 84.8 per cent more than was produced. When this figure is reached, it becomes obvious that the NSPPC ignored not only production for profit but also the human factor. In 1929, whether the system was operating for profit or not, there was not sufficient labor, and especially trained labor, to produce according to the NSPPC figures. In general, the argument presented by Dr. Polakov is like assuming that there is "waste" capacity *necessarily* if there is excess capacity; and yet it would be a sadly short-sighted type of economic planning (even when done for use and not for profit) which did not build and equip plant and machinery capable of meeting a growing market during the life of that material equipment.

A general summary of the technological problems of economic planning are discussed in an excellent final chapter of the book by Mary van Kleeck, the full implications of which should be thoroughly studied by all "economic planners."

The liveliest chapter in the book is the one written by Earl Browder, in which he attacks all the capitalistic, New Deal, Fabian socialistic, technocratic, and EPIC types of planning. Going back to first principles, which to

him are those of Marx and Engels, he quotes extensively from the *Communist Manifesto* and from Lenin. Standing foresquare on his Marxian tenets he proclaims the forthright revolutionary doctrine that the only solution is the dictatorship of the proletariat. There is no pussyfooting here—if for no other reason, this book is worth having because it contains Browder's vigorous presentation of the views of the fighting communists.

JAMES G. SMITH

Princeton University

*Economic Planning and the Tariff: An Essay on Social Philosophy*, by James Gerald Smith. Princeton: Princeton University Press. 1934. x, 331 pp. \$3.00.

This work is an analysis and criticism of what is called economic planning, one phase of which is a tariff policy looking toward a large measure of national self-sufficiency. General economic or social planning, according to the author, "means that in this age of statistics and scientific methods we should be able to diagnose with relative precision the state of the national and world economy. It means also that because of our vast quantity of reliable statistical facts we can either *supplement* economic forces or *substitute for them* a planned direction of the economy." It is pointed out that since the World War social planning in the United States has embraced such projects as prohibition, helping European countries to stabilize their currencies and stay on the gold standard, aiding monopolistic enterprises in their price-stabilizing efforts, and raising still further our already high tariff by the Hawley-Smoot Act of 1930. The effect of the first has been a "wide-spread expansion of racketeering," and of the others, "an inflated credit structure, attempted stabilization of agriculture in this country, . . . a price structure in industry honeycombed with monopolistic stabilization schemes," and the growth throughout the world of retaliatory tariffs.

In attacking the protective tariff system the author has some illuminating chapters on the hidden costs of economic nationalism, its financial costs, contemporary fantasies of the economic nationalist, the bewilderment of public opinion, and recent efforts at tariff reform. Much of this material, though interestingly presented, covers ground with which students of international trade are familiar. The effect of tariff barriers on wage rates receives considerable attention. The absurdity of the contention that a protective tariff is necessary for the maintenance of the American standard of living (commonly known as the pauper-wage argument) is well exposed. The author, although disclaiming to be a free trader in the sense that tariff barriers should never be employed under any circumstances, sees in their general levelling an important step not only in trade revival but in the maintenance and spread of general prosperity.

The argument of the book is in substance that interference with the operation of competitive forces, whether by government or by special interests, is socially harmful. This does not mean the adoption of a pure let-

alone policy on the part of the government, but rather an "adequate use of its police power in the enforcement of conditions of free economic markets." Otherwise "competitive capitalism ceases to operate."

There is much sound criticism in the book of certain phases of what is called "economic planning." No attempt at a purely artificial control of prices, credit, and the like, such as has characterized much of our governmental efforts to aid business or relieve the economic distress of large classes of our people, can be permanently successful. Economic as well as physical relationships are governed by laws. One may question, however, such a statement as this: "*The business cycle is a product of human manipulation through governments either as a result of common blundering, or as a result of control by special interests.*" (Page 162; the italics are the author's.) Even though we may grant that the influence of "human manipulation through governments" has played a large role in our major depressions, the maladjustments resulting from variation in the relative mobility of labor and capital, and from failure of business organization to adapt itself readily to a changing technique, have been fully as potent a factor in bringing about the industrial changes which characterize the business cycle. Furthermore, unregulated competition in the utilization and exploitation of raw materials, even where there is no danger of monopoly, can be provocative of serious social waste. The regulation of competition in the interest of fair trade practices and in behalf of the conservation of natural resources do involve some measure of economic and social planning. Barring these and some other criticisms that may be made, the book is a valuable and needed contribution to the literature of an age of social experimentation and economic nationalism.

ABRAHAM BERGLUND

University of Virginia

*Prices in Colonial Pennsylvania*, by Anne Bezanson, Robert D. Gray, and Miriam Hussey. Philadelphia: University of Pennsylvania Press. 1935. xix, 445 pp. \$4.00.

This volume is No. XXVI of the Research Studies of the Industrial Research Department of the Wharton School. It is a thoroughly competent piece of work and should be of great value to students of price history and of colonial history, for it is more than a history of prices; it is almost a history of commerce. The authors have accumulated a mass of interesting information concerning the prices of the chief articles of trade in Philadelphia and the causes of their fluctuations. Their chief conclusion is that there were nine distinct cycles in prices between 1720 and 1775, of which some can be explained by wars and others cannot be completely explained. They have also established the existence of marked seasonal fluctuations, and of an upward trend in most of the prices studied, which was more rapid after 1744 than before.

In general their conclusions agree fairly well with those of other students of 18th century colonial prices. They have prepared an index of the wholesale prices of twenty commodities by months, which is without doubt the best price index that has yet been published covering that period. The peaks of price cycles shown by the index usually differ by a year from those reported for New York and South Carolina, sometimes leading, sometimes following. Similarly they differ from those found for consumers' goods in London by the present reviewer.

Likewise there is some difference between the trend shown by this index and that shown by others. From 1720 to 1774 this index rose 57 per cent, and a supplementary index of 12 commodities rose 48 per cent. Warren and Pearson's index of 10 commodities in Philadelphia rose 80 per cent in the same interval. As they were all unweighted arithmetic averages, the differences between them are partly due to the choice of commodities, and partly to the use of different base years. Stoker's indexes for New York rose 38 per cent from 1720 to 1774. Geometric averages would have shown less of an upward trend and less difference in the slope before 1744 and after. The authors of the present study did also calculate geometric averages for the period from 1731 to 1774. On the other hand, the use of weights in calculating the averages, although perhaps reducing the upward trend over the whole period, would probably have accentuated the contrast between the earlier part of it and the later, since the commodities customarily given the heaviest weights were the ones that showed this contrast most plainly.

The authors used an unweighted index because of the impossibility of deciding what weights would be correct. They also limited their index to those commodities for which monthly figures were available without too many gaps.

As they point out, the trends of the commodities studied were not alike. Turpentine, bar iron, tea, and loaf sugar declined; pitch, tar, salt, rice, pepper, gunpowder, and linen cloth had horizontal trends; and grains, meats, cotton, molasses, brown sugar, wire and staves rose. Is it not possible that we have here an illustration of the law of diminishing returns applying to agricultural products as the population increased, while at the same time improvements in manufacture and ocean navigation reduced the cost of manufactured goods and imports from Europe and the Orient? Most prices shared in the cyclical swings shown by the composite index, but their different trends make the index, like all indexes of wholesale prices of raw materials and imported goods, an unreliable basis for deductions with respect to trends in the purchasing power of money.

It is also of interest to note, in view of the present-day discussion of "administered" prices, that even in the 18th century the prices of domestic manufactured products, such as loaf sugar, rum, and iron, fluctuated less frequently and less extensively than those of raw materials. Did they have trusts in those days, or was it merely due to the fact that wages of hired laborers are an important element in cost and that they do not react promptly to booms and depressions?

If this price index is to be used only to establish the existence and timing of business cycles its construction is wholly justified. If it were to be used to measure trends in the purchasing power of money, weights would be essential, and it would be necessary to include many more commodities, especially manufactured goods, and services as well. The authors apparently realize this limitation and have announced their intention to publish studies of retail prices and wages. Perhaps when they do so they will attempt to construct an index of the cost of living of the working classes, and of real wages. The purchasing power of laborers is at least as important a subject for statistical research as the cyclical movements of wholesale prices, although it has received less attention from statisticians and price theorists.

R. S. TUCKER

Westfield, New Jersey

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*Das Problem der langen Wellen und die Entwicklung der Industriewaren-Preise in den Jahren 1820-1933*, by Juergen Kuczynski. Basel: Philographischer Verlag. 1934. 29 pp.

*Weltproduktion und Welthandel in den letzten 100 Jahren*. Statistische Studien, insbesondere zur Entwicklung unter dem Monopolkapitalismus, by Juergen Kuczynski. Liepāja (Libau): Verlag der Buch- und Stein-druckerei Gottl. D. Meyer. 1935. 72 pp.

The results of Kondratieff's famous investigation on long waves found a surprising echo in the international literature. His theoretical assumptions were weak and the statistical methods applied rather crude, but in spite of these deficiencies, which Kondratieff himself admitted, many economists of reputation speak of long waves as established facts. But do they exist at all? Dr. Kuczynski denies it categorically. In his opinion it was a great mistake of Kondratieff to include in his indices agricultural prices, since the phenomenon to be explained is specifically industrial. Excluding all commodities that were not of pure industrial origin, Dr. Kuczynski obtains fluctuations which do not show any long waves. He takes international indices and then indices separately for four leading industrial countries, namely England, United States, France and Germany. In both cases he examines in every cycle the absolute and the per cent deviation from the cycle average. The deviations do not show any regularity. Sometimes the direction is changing from cycle to cycle, sometimes the direction remains the same in two consecutive cycles, but except for France, the country of least developed industry, the price fluctuations reveal no waves of fifty to sixty years as Kondratieff seems to have found. As Spiethoff has shown, prior to Kondratieff, in some periods longer and more severe depressions prevail; in others, longer prosperities and milder depressions. This is a fact that can not be ignored. Dr. Kuczynski should therefore have examined more carefully the behavior of prices to see whether or not these fluctuations have something to do with the structural change in the type of business cycle described by Spiethoff. The existence of long waves may be question-

able, but the problem raised by Kondratieff has not been solved by Dr. Kuczynski, although his scepticism will be wholesome for further investigations.

Dr. Kuczynski's second book does not present a uniform, well balanced investigation; it is more a collection of a few papers, partly published before in the "Konjunktur-Statistische Korrespondenz," Heft 4/5, 1934. They are however united by one leading idea: to show statistically the retardation in the expansion of the capitalistic system. The author makes a distinction between two—in his opinion—entirely different periods in the industrial evolution during the last 100 years. The first period—up to the crisis of the 70's—he characterizes by free competition; the second one by growing cartellization and monopolization, which became more pronounced in the last decade of the 19th century. In the first period he finds for production a strongly increasing rate of growth, in the second a decreasing rate. Dr. Kuczynski reaches his results by examining the development of production in England, Germany, the United States, and France. He analyzes the trends in these countries, first, separately for each, and then he compares the joint trend of the four countries with that of total production of the world. The indices he analyzes do not show any long waves. The decline in the rate of increase since 1900–1909 is, according to Dr. Kuczynski, due primarily to the paralyzing influence of the growing monopolistic organization.

Examining the growth of international trade, Dr. Kuczynski comes to similar results; but here he sees the main causes in the following three factors: (1) the development of national industries, (2) the exhaustion of virginal markets, and (3) the retardation of industrial expansion.

The concluding three brief chapters, which can be considered only as an annex, deal with the problem of productivity and insufficient utilization of capacities in the United States and the problem of unemployment in Germany and the United States.

To summarize Dr. Kuczynski's results in a few words: The capitalistic system is no longer able to master the production forces on the scale of previous decades. The ideas are of course not new, neither is the statistical approach; but Dr. Kuczynski carried through his analysis with greater penetration than it has been done before. The author is aware of the theoretical and statistical pitfalls he is facing, but he underestimates the difficulties the problems involve. Does there exist a general law of industrial growth, and if it exists is it possible to prove it statistically? What is capacity from the strict economic point of view? Does there exist any possibility of measuring the influence of monopolies on insufficient utilization of means of production? Is not utilization a very complicated phenomenon attributable to different causes, which must be carefully distinguished? These and many other problems Dr. Kuczynski did not even raise. His general statement about monopolistic organization is to some extent true, but his analysis does not add very much to establish it statistically.

EUGEN ALTSCHUL

University of Minnesota

*Fluctuations in American Business 1790-1860*, by Walter B. Smith and Arthur H. Cole. Cambridge: Harvard University Press. 1935. xxix, 195 pp. \$5.00.

The authors of this study hope that they will find in their audience the student specializing in business cycles, but they intentionally attempt no better solution to the problem of the business cycle than to present evidence of "the persistence of the sequence in movement of stock values, commodity prices and interest rates." Undoubtedly, the additional material tabulated in the appendices should delight the heart of any economic statistician and should aid in future analyses.

As a matter of convenience, the period under study has been divided into three sections, namely, 1790-1820, 1820-1845, and 1843-1862. There is a certain necessary overlapping in the statistical series, since the composition of the various indexes is dissimilar for the periods. The first section has been analyzed by Dr. Smith, and the last two sections by Dr. Cole. Each section is prefaced by a general statement of the economic setting for the period, followed by chapters dealing with commodity prices, security prices, and banking. In the last two sections, the discussion of public land sales is included in the chapters dealing with stock prices, and there are also chapters dealing with the volume of trade. The final chapter of each section is a general summary based on the graphic presentation of various statistical series. This method of subdivision aids the reader materially in following the authors through a maze of complex movements without losing the sense of relationship among the series. It is impossible, however, for the reviewer to accept the implications and the conclusions of the authors in all cases. In the comparison of stock market declines of the period under study with the decline of 1929-1932, they suggest that "an index of crisis severity might be constructed in which degree of movement was weighted by its duration" which would indicate that the "decline which in severity most nearly equaled (or perhaps exceeded) that of the 1930's occurred nearly a hundred years previously." Such an index attaches no significance to the volume of trading and the wider breadth of the recent markets. Likewise, in the discussion of commodity price movements, there is the hint of favoritism for "their" indexes.

A point of major disagreement is the "catastrophe of 1837" when a "summer's fever is seen to be but a minor part of an eight-year sickness," so stated by Dr. Cole. The swing in commodity prices is used as the evidence of changing business conditions, and the period 1830-34 is said to approximate closely the "business cycle." Here the index swings from 82 to 99 and back to 86. The index then reaches a maximum of 131 (February, 1837), drops to 98 (September, 1837), to rise to 125 (February, 1839). The statement "that there was a broad upswing of price from 1834 to 1839 with a brief and temporary reaction in 1837" is unconvincing in view of the statistical evidence. Not only does Dr. McGrane's *The Panic of 1837* indicate a depression in 1838, but this view is supported by *Business Annals*.

The reader, however, can still interpret the movements for himself, because the authors are not dogmatic and suggest future attempts at theoretical analysis. The study includes 75 tables and 48 charts. Studies of this type are valuable, leading to ultimate agreement among students of business cycles.

WALTER A. BAUDE

University of Cincinnati

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*World Finance 1914-1935*, by Paul Einzig. New York: Macmillan Company. 1935. xvi, 370 pp. \$3.00.

Various aspects of the controversy over inflation and deflation are aired in a highly provocative style in a recent book by Dr. Einzig. This is one of a long series of books he has published in the field of international finance and shows again his wide knowledge both of detail and of broad questions which are of urgent present concern.

This recent volume is a summary and recapitulation. It covers in rapid survey the entire post-War period and touches on scores of crises, conferences, and agreements. These events are made the vehicle for a persistent and unrelenting attack on those who have favored deflation, who aimed at a return to an old style "normal," and who have believed that money stability in the classical sense was important to economic prosperity.

The discussion of *reflation*, and the passage in Chapter 3 in which "bank rate worship" is discussed with keen irony give an indication of almost complete rejection of the century-old ideas which have determined many central banking policies. In pushing to an extreme in some cases Dr. Einzig leaves the reader somewhat at a loss as to what he would substitute for familiar financial traditions and authorities in the event that they are completely discredited by past or future crises. He does not state a clear preference for dictatorship, communism, or the "planned economies" put forward by many "left-wingers." He even takes care to indicate that the student of the year 2000 will find the truth somewhere between two extremes. Nevertheless he uses historical incident to make more devastating his attack on the deflationists and implies at the same time that only inflation can be controlled, constructive, and rich in economic achievement.

For some students the scope and inclusiveness of the book will recommend it especially for an introduction or review. Those who come to the field without a broad knowledge of the varied happenings in currency and finance in post-War Europe may well find this book a preliminary to their further studies. To others seeking for unrevealed information and sidelights on important happenings there will be some disappointment, because this book has less new information than Dr. Einzig's former studies. It is interpretative in a general way and does not put forward much information not already available in various scattered sources.

In this case, and in other instances, Dr. Einzig has done valuable work in broadening the horizons of many who might otherwise fail to see the



far-reaching implications of financial actions or who are inclined to stress two-country, to the exclusion of more complicated, financial relationships. For instance, in describing the devaluation of the pound sterling in 1931 he places the episode in its complex setting and shows how many varied forces played upon the British currency and pressed it down. Even in giving the history of these critical events, of which he had intimate knowledge because of his many contacts in the city of London, he fails to answer some of the basic questions that still puzzle many economists. He does not clear the uncertainty in some quarters as to how short-time capital movements and the German credit situation could reverse so quickly the studied opinion of British finance emphatically stated in June, 1931, in the Macmillan Report and bring a complete shift in policy and in the position of the world's first currency.

ELEANOR LANSING DULLES

University of Pennsylvania

*Public Works in Prosperity and Depression and Their Utilization as an Agency of Economic Stabilization*, by Arthur D. Gayer. New York: National Bureau of Economic Research, Inc. 1935. (Prepared for the National Planning Board, Federal Emergency Administration of Public Works.) xx, 453 pp. 100 tables, 3 charts. \$3.00.

The book attempts a two-fold attack upon its problem; one, the examination of factual evidence, and the other a consideration of questions of theory and policy.

The greatest contribution this book makes to the statistics of public works and construction is its revision of the series of estimates of the total dollar volume of construction, public and private, presented in an earlier publication of the National Bureau of Economic Research, *Planning and Control of Public Works*, by Leo Wolman, assisted by Dr. Gayer. The estimates cover the period 1923-1932 and provide what is probably the most satisfactory comprehensive measure of the volume of construction which has been compounded out of the meager statistics available.<sup>1</sup>

Although such an estimate of total construction values is extremely useful, the inadequacy of the data upon which any such estimate must be based should be recognized. For instance, public construction is estimated to have risen from 2.97 billion dollars in 1926 to 3.71 billion in 1927, an increase of about 25 per cent. This increase was sufficient to offset a considerable decline in the estimated private construction and to cause a rise in the grand total. An examination of the constituent figures on public construction, however, reveals that 460 of the 740 million dollars total increase are accounted for by an estimated increase in expenditures for construction and maintenance of city streets and bridges, which is based upon F. W. Dodge

<sup>1</sup> The Gayer estimates have been projected through the year 1935 in an article by Lowell J. Chawner, "Construction Trends and Related Factors," in the April, 1936, issue of the *Survey of Current Business*.

Corporation figures covering only 14 cities.<sup>2</sup> City expenditures data given elsewhere in the book do not confirm the extent of the rise shown.

The author's estimates of total construction are critically compared with two similar estimates, one by Corrington Gill and one by Simon Kuznets. In addition, much of the information available on various aspects of public works activities are brought together and summarized. Unfortunately, most of the series are not carried beyond 1932, although the data on the P.W.A. extend into the early months of 1935.

The data presented on public works make it clear that the recent experience does not provide a test of the theory of public works as a stabilizing economic influence. To be sure, there was a definite lag of public construction on the downturn in 1929-31, but far from compensating for part of the decline in private construction during the depression, public works expenditures fell from a level exceeding 3½ billion annually (from 1927 to 1931), to a total about half that amount in 1933. Subsequent estimates<sup>3</sup> show an advance to a total exceeding 2½ billion in each of the years 1934 and 1935. In other words, the statistics show Federal expenditures expanding, especially in 1934 and 1935, but failing by a wide margin to restore the level of total public construction to the pre-depression volume.

Two other significant findings may be noted as emerging from the statistics presented. The most important single object of public construction expenditures during recent years has been the building and maintenance of roads, streets, and bridges. This group has constituted more than 50 per cent of the total of public construction in each year since 1927, and its proportionate importance increased to 65 per cent of the total in 1933. This important branch held up better than other public works, perhaps partly because the machinery for Federal assistance had been in operation for some time, and partly because the gasoline tax and license fees for automobiles yielded an income which shrank less than other public revenues.

The second finding which is clearly demonstrated by the statistics appears in the section on the financing of public works. The reader is left with little doubt that municipalities (where public works expenditures were first to decline) encountered grave difficulties in providing funds for continuing public expenditures during the depression. Any policy of planned public works that is dependent to any considerable extent upon cities and counties must cope with the problem arising from legal and economic limits of the borrowing power of small governmental units during depressions. Cities and counties, which had contributed around 75 per cent of all public works between 1925 and 1929, accounted for less than 40 per cent of the sharply reduced total of 1933.

A great deal of discussion but comparatively little statistical evidence is presented on the necessity for having a plan drawn up ahead of time if public works are to be effective depression stabilizers. A few cities are cited

<sup>2</sup> In fact an examination of the tables presented by the author on pages 168 and 209 would seem to indicate that about 60 per cent of the increase shown for the 14 sample cities occurred in New York City alone.

<sup>3</sup> See *Survey of Current Business*, April, 1936, p. 16.

as having a commendable record, but this record is not used to provide the basis for a model plan nor for a comparison with some of the less favorable records. Perhaps it is the author's intention to emphasize the fact that, although absence of plans presents serious obstacles to the effective marshalling of public works to combat depression, still more important is the previous planning of finances to give some effect to the plans when the time comes to put them in operation. The author, however, is not particularly hopeful on the subject of local finances. He claims that localities cannot cope individually with such a national problem as business depressions and that in the future the chief financial reliance will continue to rest on the Federal Government.

The limitations imposed on the discussion of public works by the lack of reliable statistical data provide a challenge to workers in the field of construction statistics and of public finance. For instance, the mixture of data referring in one instance to permits, in another to contracts, and in still another to expenditures for force account work, requires nothing short of legerdemain to compound an estimate of actual construction activity. Data on employment are distinctly unsatisfactory, and construction costs information is so unreliable that the author refrains from undertaking an adjustment of the dollar figures he presents to account for price change. On the question of sources of funds, the available data are extremely disorganized. In the absence of any summary measures on local conditions, it was found necessary to treat the local government section as a series of case studies of sample cities.

The discussion of theoretical problems is largely non-statistical. The reader is left with the impression that the statistical facts fail to fit the theoretical questions propounded. The theoretical discussion summarizes most of the questions already so widely discussed by others in the abstract, but practically none of the problems—extent of primary and secondary employment, comparisons of experience where advance planning did and did not exist, or an appraisal of the effects of timing of public works—is illuminated by any statistical evidence presented.

A most serious shortcoming in the presentation of the information contained in the book is the almost complete lack of charts. There are only three graphs in the book, and none of these presents series of basic significance.

HENRY B. ARTHUR

Washington, D. C.

*Standards of Living in the Cleveland Metropolitan District*, Spécial 1935  
Report of the Real Property Inventory of Metropolitan Cleveland, by  
Howard Whipple Green. 1935. 695 pp. \$100.00.

In this volume the detailed tabulations of the 1934 Real Property Inventory of Cleveland are presented. Cleveland has the distinction of being the only city of the 64 covered by the Federal Real Property Inventory for

which tabulations were made by census tracts.<sup>1</sup> This report, therefore, adds a wealth of information about each of Cleveland's neighborhood units (census tracts) to the store already accumulated and published by the Real Property Inventory of Metropolitan Cleveland. Data are presented in sets of 7 tables for each of the census tracts, for Metropolitan Cleveland, for Cleveland proper, and for the metropolitan area outside Cleveland. These tables contain information on: (1) family units by tenure, occupancy, number of rooms, type, and monthly rentals; (2) family units by tenure, monthly rentals, type, density of occupancy, condition, and facilities available; (3) owned homes, by value and encumbrance; (4) residential structures by type, age, condition, and the number of garages and automobiles; (5) family units by type of heating apparatus, by fuel used, and whether running water was available; (6) time required and mode of transportation used by wage earners to get to work; and (7) apartments by monthly rental per room, by number of rooms, and by persons per room.

There are 42 outline maps of the metropolitan district on which are shown by means of dots the differences among census tracts with respect to condition, value, rentals, facilities, and other housing characteristics. These maps provide a detailed picture of the residential composition of the city and its environs. A fold-in street map of the district showing census tract boundaries is inserted in a pocket.

The five pages of text describe the tables and also indicate the use to which the data can be put. Several census tracts in Cleveland are contrasted, and Cleveland is compared with other cities for which information is available.

Numbering of the maps and the provision of an index to the tables and maps would greatly facilitate use of the volume. The numbers indicating the census tract on each page do not stand out from the page. The use of larger figures would seem desirable. In other respects, the presentation is admirable. It is to be regretted, however, that a breakdown was not made of the large rent groups, \$20-\$29 and \$30-\$49. The ranges in these significant groups are much too wide.

As Dr. Green points out, the conditions revealed by the Real Property Inventory are not such as to make native Clevelanders point with pride, and little solace can be obtained by comparison with worse conditions in other cities. The Real Property Inventory data provide valuable ammunition for those who are trying to improve housing conditions and living standards. Also, they assist, when tabulated by small areas, in the solution of the many problems involved in large-scale housing, such as the selection of a site, the determination of the group to be accommodated, the rents to be charged, and other problems.

THEODORE A. VEENSTRA

University of Pittsburgh

<sup>1</sup> Other cities, notably New York, Philadelphia, and Pittsburgh, which conducted real property inventories as local projects tabulated the results by census tracts

*Maritime Trade of Western United States*, by Eliot Grinnell Mears. Stanford University: Stanford University Press. 1935. 538 pp. \$4.00.

Since the dominant purpose of this pioneer study of a most interesting phase of the frontier of occidental civilization is to discover and interpret significant trends, the author does not pretend to present the subject of water-borne trade in other than broad outline. His chief tools of investigation are statistics, geography, and history. Especially worthy of mention is the fact that Professor Mears constantly keeps the world picture in mind. He finds that although one may speculate concerning the possible successful conclusion of gatherings of representative men of affairs and trained students who are both able and willing to think and act internationally, there is definite merit in such meetings, "if for no other reason than to clarify divergent issues" (page 371).

Chief attention is directed to foreign commerce and to the protected intercoastal and non-contiguous trades. Although coastwise traffic along the Pacific between United States ports is large and has internal significance, it is of less economic importance to the region than its intercourse with foreign nations, with the Atlantic seaboard, and with the territories of Alaska and Hawaii.

Western United States, "the most progressive section of the nation" (page 39), is larger than the Pacific Coast states of California, Oregon, and Washington. This region embraces, "as a tributary area," the Rocky Mountain states of Montana, Idaho, Wyoming, Utah, Nevada, Colorado, New Mexico, and Arizona. The non-contiguous territories of Hawaii and Alaska are also included. Guam, the Philippines, and American Samoa are excluded because of their greater alignment with the Orient than with the Western Hemisphere. Maritime commerce of the West Coast has been stimulated by the growth of population but even more by the increase in the number of new trade routes made possible by the opening of the Panama Canal.

Professor Mears calls attention to the "superabundance of Coast optimism relative to the great future of the Pacific area" and warns of the "manifest dearth of bona fide concrete information concerning it" (page 432). Nevertheless, after painstaking efforts to synthesize a great variety of interrelated factors involved in an evaluation of a perplexing problem, he calls himself "a cautious optimist," at least for the future of our Western States. He finds that the center of the world's commerce is definitely shifting to the Pacific with accelerating speed, although he admits that European trade still dominates United States foreign trade today. The merchandise imports of Western United States "increased from \$60,000,000 in 1900 to \$129,000,000 in 1913, to \$523,000,000 in 1929, and then declined to \$121,000,000 in 1933; correspondingly, merchandise exports gained from \$72,000,000 in 1900 to \$147,000,000 in 1913, to \$595,000,000 in 1929, and declined to \$198,000,000 in 1933" (page 446). The recent "abnormal slump" in trade is a "temporary phenomenon."

In his dual rôle of historical geographer and economist, Professor Mears

considers such subjects as coast ports and services, freight and passenger traffic, shipping conferences, and subsidies. There are several chapters devoted to geographical and historical background. Chapter VII—Some Pitfalls in Shipping Statistics, and Appendix D—Official Statistical Sources, warn the reader that a large amount of the data concerning the region is published by biased institutions, which issue reports without accompanying explanations of source or method. It is necessary to recognize the distinction between transportation statistics, which show place-to-place movement, and trade statistics, which indicate the commercial exchange of goods. According to the author, "trade statistics may show either the immediate exchange between regions in which are located the seller and the buyer, or they may show the movement between the regions of origin and final destination" (page 148). Although sometimes identical with *transportation* statistics, and again with *ultimate trade* statistics, immediate trade statistics often are not identical with either.

It is unfortunate that separate organizations publish figures which "differ hopelessly," though they presume to cover the same commodities. There is a distinct lack of agreement with respect to (a) the period involved, (b) the classification of sea "trades," (c) the classification of commodities, and (d) the units. Despite these limitations, the different records constitute "the one indispensable basis for observing the movements in merchant shipping" (page 418).

Those whose limited time prevents a reading of the entire volume and a study of its numerous charts, graphs, and tables of statistical data will enjoy perusing Professor Mears' *Résumé* and his *Forecast*. It may also prove interesting, some twenty years hence, to pick up this book again and to observe to what extent the interpretations have been borne out by history.

WILLIAM H. KOENIG

Columbia University

*Earnings of Skilled Workers in a Manufacturing Enterprise 1878-1930*, by Evan Benner Alderfer. Philadelphia: University of Pennsylvania Press. 1935. xi, 88 pp. \$1.50.

"The most startling discovery" of this monograph, submitted as a doctoral dissertation at the University of Pennsylvania, is that, "at the early age of 31 and thereafter, earning power should be on the decline and that better than average earning capacity should be confined within the narrow range of 24 to 38 years of age. . . . Our results serve at least to raise the question whether this attitude," expressed as the crushing effects of mechanization "is not unduly tinged by overzealous veneration of the past." In these words, Dr. Alderfer summarizes and gives emphasis to his analytical survey of data (made available by an anonymous firm) covering 52 years of annual earnings and occupational experiences of a group of 3,823 apprentices and of similar data covering 2,413 journeymen from 1895 to 1930.

Other facts providing some inductive confirmation of our theory relating to labor mobility, earnings, and the problem of unemployment are given. For example, voluntary separations increase during the up swing of the business cycle; dismissals and lay-off, particularly among the higher paid journeymen, were resorted to in depression years; 90 per cent of the apprentices withdrew from the company by the end of their third year of employment; of the journeymen entering the employment of the company at the age of 18, 61.5 per cent withdrew at or before the age of 31; money wages paid the journeymen in 1920 were 28 times the amount paid in 1895, although the value of output had increased in this period only 15 times; the curve of earning capacity of the workers closely approximates the normal curve, except for those years in which changes either in the methods of wage payment or in the arts occur, with a tendency towards greater dispersions in years of prosperity. In Chapter VI, the author analyzes the earnings and employment records of 49 workers employed by the company for 20 years or more. The average annual earnings and the regularity of employment were uniformly above those for any other group comparable with respect to age, experience, and training.

The effectiveness and value of Dr. Alderfer's work would have been enhanced if he had related his findings to what others have done in this field. Surely, to mention only two contributions in this field, the works of Professor W. I. King and Professor P. H. Douglas deserve consideration. Since no mention is made of union organization, strikes, and other problems in labor relations, are we to conclude that in 52 years this anonymous company experienced no difficulties of this sort? These and other questions lead the reviewer to feel that the author has given too much attention to statistical techniques and not enough to the consideration and interpretation of important factors which lie outside but which nevertheless affect the data and conclusions of the study.

JACOB J. BLAIR

University of Pittsburgh

*Publications of the Statistical Institute for Economic Research, State University of Sofia, Bulgaria. No. 1. 1935.*

This is the first issue of the publications of the Statistical Institute for Economic Research, organized in 1935 (by special law) at the State University of Sofia. The Institute is financed partly by the Rockefeller Foundation and partly by subventions from the national and the agricultural banks of Bulgaria. The purpose of the Institute is an impartial study of the problems of the national economy of Bulgaria, particularly its current business situation, as well as of the world economic problems affecting Bulgarian national economy. It is a new Institute which will pay much attention to the analysis of the business conjuncture. The organization of such an institute in one of the Balkan agricultural countries must be greeted. These

countries have their particular economic problems, their business much depends upon their agriculture, and, for this reason, the studies of the Institute may be of particular interest.

Among the articles published in the first issue must be mentioned a paper by Professor O. Morgenstern, associated with a similar institute in Austria, discussing the organization and the problems of a conjuncture research, and an article by Professor Oskar N. Anderson, studying the price disparity problem in post-War Bulgaria. The fact that Professor O. Anderson, a well-known statistician, one of the initiators of the "variate difference method" in statistical theory, has been appointed the Director of the Bulgarian Institute may be a guaranty that its publications will be on the level of scientific standards.

All studies are published not only in Bulgarian but also in one of the West-European languages: English, German, or French, which makes them accessible to the readers outside of Bulgaria.

V. P. TIMOSHENKO

U. S. Department of Agriculture

*Industrial Organization in India*, by P. S. Lokanathan, No. 4 of the Studies in Economics and Commerce of the London School of Economics and Political Science, edited by Professors A. Plant, L. Robbins, and A. J. Sargent. London: George Allen and Unwin Ltd. 1935. 413 pp. 15 shillings net.

Dr. Lokanathan's *Industrial Organization in India* is an excellent and scholarly work in a field that has often been clouded by partisan discussion. It is an analysis of the financial organization of Indian industry by an Indian who is thoroughly conversant with the facts and the problems and who is not seeking either to place blame or to glorify. The preparation of the book has taken five years of study during which the author not only visited the important industrial centers of India but also traveled to Europe to gather comparative material. The result of this labor is a well balanced treatise.

The story of the organization of Indian industry is primarily a story of the managing agency system which is so distinctively a feature of Indian large-scale industry. The system was first imported by the British as a convenient means of providing both capital and trained leadership in a country where indigenous capital was scarce and administrative and technical skill had to be imported. It was the basis upon which the early jute mills, the tea estates, and the coal mines were first developed. The managing agents provided the first capital and acted as the managers of the enterprise they promoted. The system was perhaps the most effective one that could have developed under the existing conditions in India at that time. As Dr. Lokanathan says:

"But for the managing agency system the pace of industrial development



in India would have been slower, and the opportunities for British capital and British enterprise to function in India would have been limited. Thus England and India both gained."

Indian capitalists, especially in the cotton industry in Bombay and Ahmedabad, took over the system from the British, though with certain characteristic differences. The British managing agency, at its best, combined financial administration with industrial experience and knowledge of the technical problems of the industry involved. The Indian managing agency firms have been financial rather than industrial in character; and because of that fact they have often failed where the British have succeeded. Both types gave rise to abuse, especially in the practices through which managing agencies received remuneration; for a managing agency may receive not only the returns on capital invested, office expenses and a minimum commission for management which must be paid regardless of the success of the mill, but also commissions on production, commissions on sales and on purchases, and commissions on profits. Under this system, it is quite possible for a managing agent to be making money on a mill that is actually losing money.

The concentration of control in the hands of the managing agents rather than in a board of directors; the speculative sale of the managing agency for purely financial reasons and without consideration of the industry; the provision of credit on the good name of the agency rather than on the industrial project; and questions of efficient management are some of the problems that are analyzed and discussed in this volume. There is also a very good chapter on the localization of industry and a last chapter on wages, standard of living, and efficiency which summarizes the fundamental aspects of the labor factor in Indian industry with interesting comparisons with Japanese and Western labor.

JOHN E. ORCHARD

Columbia University

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*Die Groszhandelspreise in Deutschland von 1792 bis 1934*, by Alfred Jacobs and Hans Richter.

Sonderhefte des Instituts für Konjunkturforschung, Nr. 37, Berlin: Hanseatische Verlagsanstalt, Hamburg. 1935. 111 pp. 15 RM.

This study presents an index number of wholesale prices in Germany covering about one and a half centuries. There are 224 series of prices of 45 commodities for 106 markets. The index numbers are a weighted arithmetic mean with 1913 as the base year. The authors point out that for short periods of time, index numbers based on stable weights may be satisfactory because the composition of trade does not change decidedly. But if the index numbers cover a long period, changing weights are necessary. This is especially important in this study of prices in Germany because of the shift from a predominantly agricultural economy to an industrial one. For this reason the index numbers were calculated by three methods:

1. On the basis of fixed weights based on the average consumption per capita in the years 1850 to 1913. The proportion of agricultural foods to industrial products was 1:1.

2. The 143 years were divided into 5 parts, with fixed weights for each period, but differing from period to period. The periods were as follows:

1792 to 1830—The Napoleonic War period.

1820 to 1850—Relatively stable prices.

1840 to 1873—Upward movement of prices.

1860 to 1895—Downward movement.

1885 to 1934—Generally rising prices.

In each case index numbers were calculated for an overlapping period of 10 years. The index number for each period was weighted by the average consumption of the period. The weights for home grown agricultural products varied from 73 per cent in the first period to 30 per cent in the fifth.

3. An index number was calculated with yearly changing weights by the chain method.

The price series were generally comparable with respect to kind, quality, measure, point of sale, and usage. When a change in grade occurred, an overlap of three to ten years was used to test the degree of correspondence of the movement of the prices. Differences in weights and measures were eliminated by conversion to kilograms and liters.

Because of the lack of uniformity of the German currencies before 1873, all prices were computed in terms of the goldmark. The silver prices were converted to gold at the ratio 1:15.5, which was the rate at which the change to the gold standard was made in Germany in 1873. The authors did not consider the year to year fluctuations in the ratio. This seems to be justified by the fact that the changes were small; and the average of all years was 1:15.6.

The study includes a short summary of the history of the most important German currencies: Hamburg Mark Banko, Prussian Taler, and South German Gulden.

Another section of the study deals with the major fluctuations of prices. The authors found 26 cases when prices changed more than 10 per cent in one year; and 12 cases when the change was more than 25 per cent in a period of seven years or less.

The study clearly indicates that, although year-to-year fluctuations in prices in Germany departed from those prevailing in the United States and England, the long-term trends are very similar. Furthermore, the index numbers of individual commodities and groups moved much the same as those in other countries. The authors found that chemicals, textiles, and colonial products fell relative to the general price level; and that agricultural products were stable or rose. These long-time relationships are in apparent agreement with those found in the United States.

The student of prices will appreciate the detailed tables of commodity

prices with copious footnotes in the appendix and the comparative index numbers based on fixed and variable weights.

The student of money and history will appreciate the careful summary of German monetary history in the 19th century. The casual reader can summarize quickly the major changes in the prices of individual commodities as well as the general price level by studying the 29 well-constructed charts.

This study is a thoroughgoing analysis that every student of prices, money, and economic history will find worth while.

BARBARA GOK

Ithaca, New York

*American Bank Failures*, by C. D. Bremer. New York: Columbia University Press. 1935. 144 pp. \$2.25.

The dismal side of banking in the United States has not received consideration commensurate with its importance. Although insolvency has constituted the primary disturbance in the post-War banking revolution, the literature of banking has relegated the subject to a minor position. This work on American bank failures is a creditable attempt to overcome the deficiency.

The book begins with a general summary of bank failures since 1865, special emphasis being given to the debacle of the 1930's. Succeeding chapters cover (1) failures before 1921, (2) failures, 1921-1933, (3) liquidation of national banks, (4) liquidation of state banks, (5) responsibility for failures, (6) banks and the security markets, and (7) the guaranty of deposits. Most unfortunately the book went to press shortly before the enactment of the Banking Act of 1935. Discussion of current legislation on the guaranty of bank deposits is based on the banking bill passed by the House of Representatives and on the recommendations of the Senate subcommittee. Significant alterations were made in the bill as it was finally approved on August 23. It would be desirable to have a leaflet inserted indicating the changes, although the reader can get all the required information by referring to Title I of the Banking Act of 1935 (reprinted in the *Federal Reserve Bulletin*, September, 1935).

As a non-technical discussion of mortality rates in banking since 1865, *American Bank Failures* is a valuable addition to banking literature. It covers most of the outstanding phases of the problem. Contentions are usually supported with factual material. The main "field work" was done in the collection of data on liquidation of state banks, a previously neglected angle of the subject. Data obtained on these liquidations were admittedly cursory. They reflect the perfunctory nature of control exercised by state banking departments. The chapter on the liquidation of state banks accordingly is as suggestive for what it necessarily omits as for what it includes.

Many readers will be interested in the examples (Chapter 6) of concentrated ownership in small unit banks. Local banks too frequently are not community projects—as they are supposed to be. Typically, they are instruments of small cliques. The author does not investigate ownership of

chain or group banks, nor does he consider any possibility of getting better representation of the public in the banks. The argument, therefore, is not decisive one way or another, although the author manifests opposition to the small unit banks.

The book has limited usefulness for those desiring a thorough discussion of alternative choices available for elimination of bank failures. Statistical material is selective, and it is subjected only to elementary analysis. The first three chapters are marred by occasional loose description. The statement is made, for example, that 19,000 banks were "placed in receivership or forced to restrict or suspend operations between 1865 and December 30, 1933, on account of inability to meet the demands of depositors" (p. 12). The qualification at the end of the sentence is misleading in that the figure quoted refers to total failures including those not associated with depositors' demands.

Some phases of bank failures that a work of this general scope should include are neglected. Nothing is mentioned about seasonal tendencies in failures, although the seasonal factor probably had a considerable influence on some of the data (e.g., those given on p. 14). One would like to know, for defunct national banks at least, the variability of payments to depositors and the duration of the receiverships. Could depositors count on a reasonably large percentage of recovery within a reasonably short time, or were they subjected to great uncertainty and endless delay? Surely these points should not be overlooked even in a book dealing mainly with summations and central tendencies.

WILBERT G. FRITZ

University of Pittsburgh

*Recording of Local Health Work*, by W. F. Walker and Carolina R. Randolph (in cooperation with the Committee on Administrative Practice of the American Public Health Association). New York: The Commonwealth Fund. 1935. xvii, 275 pp. \$2.00.

The foundation of all sound statistical work is the accumulation of reliable basic data. Therefore this handsome volume is of significance for all statisticians although its more direct usefulness will be confined to those members of the fraternity who are working in the field of health administration.

The need for better records of health service has been generally realized as a result of the work of the Committee on Administrative Practice of the American Public Health Association during the past fifteen years. Efforts to meet that need have been furthered by the Commonwealth Fund in connection with its health demonstrations, by the State Department of Health of Tennessee under the leadership of Dr. E. L. Bishop, and, particularly, by the Sub-Committee on Record Forms of the Committee on Administrative Practice under the chairmanship of Dr. G. C. Ruhland.

The present volume is based on and embodies all this earlier work and presents, in full size facsimile, report forms and record forms useful in health

department budgeting and accounting, in the registration of vital statistics, individual and family folder records, medical and nursing records, and clinic records, placards, quarantine notices, complaint forms, records of services and case histories useful in communicable disease control, maternity and infant welfare and school health service, dental services, sanitary inspection, food and milk control, and laboratory service. The purpose of each form and its method of use are explained and brief chapters at the beginning and end of the book discuss the philosophy of record-keeping and the interpretation and graphic presentation of data.

The forms presented are the result of years of experimental use, and they bear the approval not only of the American Public Health Association but also of the National Organization for Public Health Nursing, the American Social Hygiene Association, and the National Tuberculosis Association. In preparing and publishing this volume, Dr. Walker and Miss Randolph and the Commonwealth Fund have rendered an invaluable service to the cause of sound public health practice.

C.-E. A. WINSLOW

School of Medicine  
Yale University

*Les Migrations de la Population Intéressant le Territoire de la Tchécoslovaquie Actuelle* (depuis le XVII<sup>e</sup> siècle à nos jours), by Ivo Sasek. Geneva. 1935. 174 pages. 5 s.f.

The task of describing the migratory movements across the border of present-day Czechoslovakia during the last three centuries is as interesting as it is difficult, owing to the fundamentally different political history and administration of the parts comprised in the state created in 1919. The author of the present study has the merit of having compiled a great amount of data referring to the problem from numerous sources, although he did not quite succeed in molding the multiform data won from statistics of widely differing character into a concentrated and lucid presentation. This criticism refers particularly to the parts concerned with the more recent migrations.

The most compact and illuminating chapter refers to the older migrations during the 17th and 18th centuries, which were in the main caused by religious persecution of the Bohemian protestants through the Austrian counter-reformation up to the reign of tolerant Emperor Joseph II. The story of these emigrants, the "flower of the nation," their taking refuge in the neighboring countries in constant hope of armed intervention from outside powers, and their ultimate disappointment bears features of parallelism to similar phenomena of our day.

During the 19th century and up to the World War, emigration was caused by economic reasons: particularly from the poorer and more backward agricultural areas, such as Southern Bohemia and Slovakia, which sent high percentages of their large birth surplus across the borders. From 1901 to 1910, it is estimated that the territories of the present state lost by migra-

tion as many as 50,000 persons per year, i.e., one-third of their natural increase.

The new republic has made great efforts to provide outlets for its partially still rapidly growing population. In particular, the Agrarian Reform, which abolished the latifundia, operated in this direction. Economic opportunities, however, could and still cannot be developed as rapidly as the growth of the population would require, so that the government has mainly concentrated on regulating emigration and impeding exploitation of and discrimination against its emigrants. The author approves of this policy. In view of the restrictions imposed on immigration in the United States and some other countries, he is especially in favor of leading the stream increasingly into France, where Czechoslovakian immigrants adjust themselves easily to climatic and psychological conditions. Interesting with respect to similar problems in other countries is the suggestion that France should open one of her colonial possessions in North Africa to peaceful penetration by Czechoslovakian agriculturists. Still, he believes that development of domestic resources and regulation of emigration will have to be supplemented by encouragement of birth control in the most backward parts of the state.

An extensive chapter on the development of Czechoslovakian immigration into the United States will be useful to American students of immigration problems because of the compiled data on the composition and geographic distribution of this group of immigrants.

It is regrettable that the otherwise useful study does not contain any maps, which would greatly facilitate its reading.

MARIE JASNY-PHILIPPI

Washington, D. C.

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*A Test of the Consumer Jury Method of Ranking Advertisements*, by Neil H. Borden and Osgood S. Lovekin. Business Research Studies—No. 11, Harvard Business School. 1935. v, 61 pp. \$1.00.

This study of the Consumer Jury method of ranking advertisements is an important contribution toward the ultimate solution of a controversy which has long been vexed by acrimony. Borden and Lovekin have secured a number of series of advertisements the relative effectiveness of which was known through records of direct sales or of inquiries. They submitted these advertisements to various consumer juries to determine the relationship between the preferences of these juries and the known *relative* effectiveness of the several advertisements in each series. They conclude, in general, that this method of ranking advertisements is valid in judging differences in physical layout of advertisements, but that the necessity of using a jury spontaneously interested in the product or service advertised for rating advertising appeals restricts the applicability of the method, ordinarily, to products having fairly general use or interest.

When a study is so patently careful and significant, a consideration of possible limitations in its application to actual advertising cannot be regarded as a derogation.

The first question that the analysis suggests to the reviewer is whether any ranking of appeals can be trustworthy unless the jury used is typical of the audience supplied by the particular advertising medium expected to carry the advertisement. It is clear that appeals which would be dynamic for readers of the *New York Times* might not be dynamic for readers of a sensational tabloid, and *vice versa*. More important is the possibility that the editorial content and associative *milieu* of a magazine will condition its readers for or against a particular appeal, so that the same reader might be responsive to an advertisement in one magazine, and not to the same advertisement in another magazine. There is considerable reason for believing that it is more important to test the responsiveness of particular audiences than to rate several appeals by means of an unconditioned audience.

A similar consideration—especially in view of the authors' requirement of a jury spontaneously interested in the product or service advertised—is the doubt whether this technique is applicable to those appeals stimulating primary demand as well as to those stimulating selective demand. Since the stimulation of primary demand requires the arousing of a latent want, it might be difficult to select a jury suitable to the task.

Finally, there seems to the reviewer a real doubt concerning the adequacy of the statistical approach recommended to determine the number of interviews needed for reliability. In dealing with an adequate number of random occurrences from a reasonably homogeneous whole, obviously, the theory of probability is validly applicable, and the formula for P.E. can be applied. But the considerations adduced so far all point to the fact that the whole is not at all homogeneous, nor the instances constituting any sample adequately random. It therefore seems to the reviewer that the statistical approach may be somewhat too rigorous, and that more consideration should be given to the number of variables which are likely to operate against homogeneity and random selection.

In view of the importance of the problem which the study analyzes, and in view of the difficulty of controlling the variables, it seems most desirable that the authors make other analyses of the consumer jury technique, so that users of the method will have more guidance, and so that the method can be appraised on the basis of the analysis of a greater number of instances, and with a greater variety of application.

LAWRENCE C. LOCKLEY

Division of Commercial Research  
The Curtis Publishing Company

*Higher Control*, by T. G. Rose. London: Sir Isaac Pitman & Sons, Ltd. 1935. xvi, 269 pp. \$3.00.

This treatise is written with a British background and must be read with this in view if it is to be appreciated. The author offers an argument for presentation of the essential accounting figures in a less technical and more

usable form than is apparently the custom in Great Britain. He argues further for comparative statements and for the use of a twelve-month moving total compared with the results of the last fiscal period rather than comparisons of individual months in different years. "Higher Control" is defined as "a monthly survey of the functional activities of a commercial undertaking, carried out from the business, trading, and financial viewpoints, and based upon direct trend comparison between the position at the moment and the position at the last financial year."

Although great care is taken to point out the differences between higher control and budgetary control, considerable space is given to an illustration which could well have appeared in any text on budgets. A tabulation of the steps involved in "the installation of higher control" shows five steps: three in the "programme stage"; and one each in the "watching stage" and the "action stage." The steps proposed in the business or sales division show striking similarity to the steps involved in the installation of a budget.

Programme Stage

First Step

Decide on desired profit, either:

- (a) On net worth; or
- (b) Reasonably attainable

Second Step

Fix turnover (sales volume) necessary to obtain desired profit

Third Step

Split turnover by products and territories

Watching Stage

Watch:

Sales trends (viz.: upward or downward slope of monthly moving annual trend)

Action Stage

Take action:

To increase sales

In the watching stage a departure from ordinary budgetary procedure may be noticed in that comparisons are with the monthly moving annual total rather than with the results of the Programme Stage. This shift apparently throws overboard many of the benefits obtainable from that stage. Budgetary authorities in this country would point out two types of advantages from the use of budgets: planning and control. Higher Control uses the first but then seeks its control in other directions.

The general thesis of the book is presented in the first five chapters. The balance is divided into two parts. Chapters 6 through 9 are a detailed discussion of the problem of presentation of results with individual consideration of each important item. Chapters are devoted to the business (sales) position, the trading (operating) position, the financial position, and control reports. A feature of real interest is the inclusion of a complete set of Board Reports for presentation to the board of directors. There is also a discussion of the more common financial ratios. The last three chapters are descriptions of particular applications of higher control to retail distribution and factory operations and a summary statement of the uses of higher control.

The reviewer is forced to the conclusion that there is little really new in



this book. To those American industrial accountants and business men who have been accustomed on the one hand to prepare and on the other hand to demand accounting reports designed for control uses, the discussion of higher control will appear at times naïve. Nevertheless, reading of what is an interesting presentation will remind even such persons of the distance we have traveled and perhaps give them new enthusiasm for further progress. It is needless to say that there are many in this country who need to read and reread a book of this type until they finally realize that accounting and statistics are service functions which are utterly futile unless the results can be and are used by those for whom the service is performed.

WYMAN P. FISKE

Massachusetts Institute of Technology

*Administration of Public Employment Offices and Unemployment Insurance. Canada*, by Industrial Relations Counselors, Inc.; *France*, by A. Gilbert; *Sweden*, by K. Bergstrom and Associates; *Switzerland*, by Dr. F. Mangold. New York: Industrial Relations Counselors, Inc. 1935. xi, 397 pp. \$3.50.

This is the third volume in the Unemployment Office and Unemployment Insurance Administration Series, of the Industrial Relations Counselors, Inc., the two earlier volumes being devoted to Great Britain and Germany. This volume deals mainly with the placement work of the public employment offices in the four countries mentioned in the title but includes brief accounts of the unemployment insurance systems in all but Canada.

The treatment of these subjects is almost exclusively descriptive, with little attempt at appraisal. It is distinctly "an inside account," being based upon statutes, rules and regulations, official statistics, and information gained at headquarters. Nothing at all is given on the reactions of employers and employees toward the public employment offices. The only conclusions reached are that the Federal-provincial system of the organization of the Canadian employment offices, as it existed prior to the recent nationalization of this service, had "many limitations," and that voluntary, governmentally subsidized unemployment insurance in France has not provided protection to nearly as large a percentage of the workers as have the compulsory systems of other countries.

In the Foreword the hope is expressed that this series of research studies will have "practical value" for the "organizers and administrators" of the United States Employment Service, "as well as for business executives, labor officials, and others concerned with its social significance." The "practical" aspect seems doubtful, particularly for others than the "organizers and administrators," but the genuine "value" is very certain. This book makes available for the first time in English, a comprehensive, and no doubt accurate, account of the organization of the public employment offices in four countries and, in a briefer manner, gives a description of the unemployment

insurance systems in three of these countries. By itself, it may have only very limited "practical value," but as a source of information for a broader treatment of these subjects it is distinctly worth while.

EDWIN E. WITTE

University of Wisconsin

*The Budget in Governments of Today*, by A. E. Buck. New York: Macmillan Co. 1934. vi, 349 pp.

The reader who wishes a broad view of the budgetary systems of the chief nations of the world will find in this volume a simply written account that will introduce him to the subject and at the same time present him with some clearly defined conclusions that have been reached by the author in the course of his long experience in the study of budgets. The basic considerations that weigh most with the author in reaching his conclusions are usually given, but supporting data are not presented in abundance, and the volume seems indeed to be intended more for the general reader in government than for the research student of budgeting—with the important qualification that the many significant items respecting budgetary practice abroad will add to the information of, and above all suggest new fields of research for, the American student. Probably the best feature of the book is the constant comparisons and contrasts of country with country that it lays before the reader.

The English system of budgeting is the one to which the author most inclines, on the whole. Thus, in suggesting changes in Federal budgetary procedure, he says that appropriations should be made in lump-sum amounts rather than in segregated items, and the administrative officers should not be permitted to spend these appropriations without the approval of the executive; the executive should explain his budgetary proposals before the legislature in open session, and the legislature should not attempt to produce through its committees a substitute plan of its own; the controlling and accounting functions should be separated from those of post-auditing, and a special Congressional committee should review the results of the post-audit.

The attempt of the book to cover a large area necessarily involves the author in some interesting problems of delimitation of his field, especially in Chapters II (General Aspects of the Budget) and V (The Budget as a Financial Plan). Federal control of state administrative standards with respect to highways, education, and health (p. 61), Federal-state-local tax relations (p. 62), expenditure retrenchment (p. 74), and, indeed, the general problem of whether a budget should be balanced during depression (pp. 70, 115) are touched upon. Unfortunately, the treatment given these topics is so brief and inadequate that it is in danger of leaving the general reader with a seriously over-simplified view of some important and complex problems. On the other hand, the author does not include within the scope of his

survey such important parts of budgetary technique as the relative accuracy with which different kinds of expenditure and tax yield can be estimated, and the methods available for estimating the yield of progressive-rate taxes. It would be helpful to get the opinion of budget students on the nature and extent of the difficulties of forecasting for so-called "cyclical" budgets, especially in view of the current tendency of emergency expenditures to become permanent expenditures when checks on expenditures are as few as they are under existing American practice.

A selected bibliography with comments and a highly detailed index add markedly to the usefulness of the volume.

CARL SHOUP

Columbia University

*The Presidential Vote, 1896-1932*, by Edgar Eugene Robinson. Palo Alto, California: Stanford University Press. 1934. ix, 403 pp. \$6.00

*Voting Behavior in the United States*, A Statistical Study, by Charles Hickman Titus. Berkeley: University of California Press. 1935. 74 pp. \$.75.

Both publications present the results of what purports to be the application of statistical methods in the field of political science, the first being primarily a collection of voting data for all counties in the United States, whereas, the second is concerned with a statistical analysis of voting data. Both are disappointing, the first because the historian failed to appreciate the difference between primary and secondary sources, and the second because visual or graphic approximations and very elementary methods were used to solve important and complicated problems.

Professor Robinson's book is principally a compilation of data, for out of the 403 pages 358 are given over entirely to tables and notes which explain them or list sources, and the remaining 45 pages include ten full-page plates showing for each of the ten presidential elections a map with Democratic counties in black, Republican counties in white, non-Democratic, non-Republican counties dotted, with other designations for tied counties, no returns, unorganized, and territories.

On page vi we read:

For the use of students who wish to go more deeply into this study and this method, extensive notes have been added, both in explanation of the distribution of the vote and in comment upon the returns from each of the states. It is believed that the ground work has been laid for innumerable studies of economic and social, as well as of political, significance. Herewith are presented the vote and its distribution. *This is the historical record.* (Italics added.) Others will use it as their interests and methods dictate.

The author seems rather optimistic when he writes, "This is *the* historical record." Perhaps it is only another historical record, for the reviewer has found that there are too many historical records. Textbooks on American

government and history, almanacs, and official state documents differ seriously in many cases. Professor Robinson recognizes this difficulty on pages 131-132:

Many state documents and a number of manuscript returns contain inaccuracies in addition and transposition of figures and names. It has been found that state totals published in state documents and in other printed sources are frequently changed in subsequent editions of the same kind, yet changes in county returns have not been made to accord with new state figures. Computations have been checked, obvious transpositions rearranged, and typographical errors corrected. Readers will find, therefore, that the totals by state and nation herein presented do not always correspond with state totals as reported in state documents or with national totals which, although appearing in national documents, are based upon state reports.

The prospective user of this book may well ask if the changes made by Professor Robinson were really beneficial. Did his change or failure to change always increase the accuracy? Only a careful study of the data can provide an answer, and the limitations of this review prevent an adequate discussion of the study the reviewer has made. For Missouri, 27 errors were found, two of them so serious as to give the victory to the wrong party (Caldwell County in 1900 and Pemiscot County in 1924). Twelve errors were found in the data for Illinois. Most of these errors occurred because Professor Robinson had too much confidence in other "accessible summaries, notably *The World Almanac*" when he found that the state votes did not agree with the totals of the county votes given in state manuals or documents. This procedure seems to ignore the important distinction between primary and secondary sources.

Professor Titus seeks to determine "scientific laws of voting behavior." The one law in which he has the most confidence at the end of his study is "The larger the P[population] or VP[voting population] of a political unit the smaller the VC[vote cast] relative to P[population] or VP[voting population]." This statement sounds as if it were the result of a correlation or covariance study, but the author did not use either of these techniques to determine the "law." Instead of correlating population and votes cast per 1000 population for one election or using covariance when seven or more elections were included, Professor Titus classifies the data with respect to size of population and computed averages of the votes cast per 1000 population for each election separately. After inspecting these results he formulates the "law." To some people such a general non-quantitative "law" could not be scientific, and moreover this law is not satisfactorily proved statistically. Professor Titus starts out with five classes of cities according to size. The mean number of votes cast per 1000 population does not increase regularly from the largest cities to the smallest cities, so he combines the four smallest classes of cities into two classes, leaving the largest cities as before. With these three classes he is able to show some negative relationship, but the scientific law is based upon only three observations—averages for large, medium, and small cities. This base is a weak foundation. Without

using the analysis of variance and covariance, he is at a loss as to how to combine his information for different elections. Presumably he does this mentally. No information is given on the number of cities studied or on the number in each class. A footnote referred to an article in the *Southwestern Political and Social Science Quarterly*, which contains Professor Titus' earlier work on the same data in 1928. Only 22 cities were studied, and only two of them fell in the class of large cities until late in the period when a third city became large enough to fall in this class. The large cities cause a very skewed distribution, and when they are eliminated the correlation is not significant. Furthermore, Professor Titus inspects correlation between means of classes, whereas he formulates his law in terms of correlation between original observations. These two should not be confused.

The work contains other illustrations of a poor choice of technique, such as the feeble attempt to separate the long time trend in the exercise of the voting privilege and the effect of extending this privilege to women.

HARRY PELLE HARTKEMEIER

University of Missouri

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## CONTENTS

An Empirical Method of Calculating Future Population. By P. K. WHELPTON . . . . .	457
The Application of Sampling to Economic and Sociological Problems. By A. L. BOWLEY . . . . .	474
Corporate Earnings on Share and Borrowed Capital in Ratios of Gross Income (1918-1935). By LELAND REX ROBINSON . . . . .	481
The Practical Side of Trade Association Statistics. By C. W. HALLIGAN . . . . .	491
Changes in the Wholesale Price Index in Relation to Factory Employment. By IRVING FISHER . . . . .	496
Discussion. By MORRIS A. COPELAND . . . . .	503
Rejoinder . . . . .	505
Factorial and Correlational Analysis of the 1934 Vote in Chicago. By HAROLD F. GOSNELL and MARGARET J. SCHMIDT . . . . .	507
Principal Components. By M. A. GIRSHICK . . . . .	519
The Negro as a Factor in the Nation's Labor Force. By ALBA M. EDWARDS . . . . .	529
The Swedish Census of 1935-6. By DOROTHY SWAINE THOMAS . . . . .	541
Rates of Mental Disease Among Certain Population Groups in New York State. By BENJAMIN MALZBERG . . . . .	545
A Broadened Program of Bank Reports. By MORTIMER J. FOX, JR. . . . .	549

## NOTES

The Statistical Work of The National Fertilizer Association. By CHARLES J. BRAND . . . . .	552
Statistical Probability. By M. S. BARTLETT . . . . .	553
Note on An Index of Bond Prices. By A. WILLARD TURNER . . . . .	555
Progress of Work in the Census Bureau . . . . .	558
Graphic Presentation . . . . .	560
Letters to the Editors . . . . .	561
A Correction . . . . .	562
Chapter Activities . . . . .	563
Statistical News and Notes: Securities and Exchange Commission (578); Board of Governors of the Federal Reserve System (578); Federal Deposit Insurance Corporation (579); Federal Trade Commission (579); Bureau of Foreign and Domestic Commerce (579); Bureau of Agricultural Economics (581); Interstate Commerce Commission (582); Division of Economics and Statistics, Federal Housing Administration (582); United States Bureau of Labor Statistics (584); United States Employment Service (585); Division of Social Research, Works Progress Administra-	

*Continued on next page*

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NOTES—(Continued)

tion (586); Division of Research, Statistics and Records, Works Progress Administration (588); National Research Project, Works Progress Administration (591); Women's Bureau, U. S. Department of Labor (592); Children's Bureau, U. S. Department of Labor (592); U. S. Public Health Service (594); Office of Education (594); National Resources Committee (595); Division of Placement and Unemployment Insurance, New York State Department of Labor (597); Dominion Bureau of Statistics, Canada (598); National Bureau of Economic Research (599); Wharton School of Finance and Commerce, University of Pennsylvania (599); National Industrial Conference Board (600); Institute of Mathematical Statistics (601); Dr. Otto Neurath (601).

Malcolm Churchill Rorty . . . . .	603
New Members . . . . .	605

REVIEWS

Dublin and Lotka: <i>Length of Life, A Study of the Life Table</i> , by RAYMOND PEARL . . . . .	608
Allen and Bowley: <i>Family Expenditure: A Study of Its Variation</i> , by FAITH M. WILLIAMS . . . . .	610
Allen and Bowley: <i>Family Expenditure: A Study of Its Variation</i> , by HENRY SCHULTZ . . . . .	613
Williams and Zimmerman: <i>Studies of Family Living in the United States and Other Countries: An Analysis of Material and Method</i> , by WARREN C. WAITE . . . . .	617
Frisch: <i>Statistical Confluence Analysis by Means of Complete Regression Systems</i> , by FRANCIS MCINTYRE . . . . .	619
Kelley: <i>Essential Traits of Mental Life</i> , by KARL J. HOLZINGER . . . . .	620
Holmes: <i>An Outline of Probability and Its Uses</i> , by W. EDWARDS DEMING . . . . .	622
Sorenson: <i>Statistics for Students of Psychology and Education</i> , by HERBERT A. TOOPS . . . . .	624
Arkin and Colton: <i>Graphs—How to Make and Use Them</i> , Rigglesman: <i>Graphic Methods for Presenting Business Statistics</i> and Goslin and Goslin: <i>Rich Man, Poor Man—Pictures of a Paradox</i> , by FREDERICK E. CROXTON . . . . .	625
Cassel: <i>On Quantitative Thinking in Economics</i> , by CHARLES F. ROOS . . . . .	627
Moulton: <i>Income and Economic Progress</i> , by EMIL LEDERER . . . . .	629
Einzig: <i>The Future of Gold</i> , by G. W. HEDLUND . . . . .	631
Adarkar: <i>The Theory of Monetary Policy</i> , by ELEANOR L. DULLES . . . . .	633
Dowrie: <i>Money and Banking</i> , by CHARLES S. TIPPETTS . . . . .	635
Nogaro: <i>Les Prix Agricoles Mondiaux et la Crise</i> , by ROBERT B. SCHWENGER . . . . .	637
National Industrial Conference Board, Inc.: <i>American Agricultural Conditions and Remedies</i> , Preliminary General Review, by A. B. COX . . . . .	638
Bussing: <i>Public Utility Regulation and the So-Called Sliding Scale</i> and Falck: <i>Economics of Electric Distribution, Effects of Reduced Rates in TVA Service Areas</i> , by EDWARD S. MASON . . . . .	641
British Association Research Committee: <i>Britain in Depression, A Record of British Industries since 1929</i> , by H. GORDON HAYES . . . . .	642
Schmalz: <i>Operating Results of Department and Specialty Stores in 1934</i> , Schmalz: <i>Operating Results of Department and Specialty Stores in 1935</i> and Teele: <i>Expenses and Profits of Limited Price Variety Chains in 1934</i> , by JAMES H. GREENE . . . . .	643
Bakke: <i>Insurance or Dole? The Adjustment of Unemployment Insurance to Economic and Social Facts in Great Britain and National Industrial Conference Board, Inc.: Unemployment Insurance</i> , by BRYCE M. STEWART . . . . .	646
Selekman: <i>Law and Labor Relations, A Study of the Industrial Disputes Investigation Act of Canada</i> , by CARROLL R. DAUGHERTY . . . . .	648
Balderston: <i>Executive Guidance of Industrial Relations, An Analysis of the Experience of Twenty-Five Companies</i> , by H. F. BROWNE . . . . .	650
Labor Research Association: <i>Labor Fact Book No. III</i> , by JOSEPH M. GILLMAN . . . . .	651

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## AN EMPIRICAL METHOD OF CALCULATING FUTURE POPULATION\*

BY P. K. WHELPTON

*Scripps Foundation for Research in Population Problems*

IN VIEW OF the large number of estimates of the future population of the United States that had been made prior to 1926 and the variety of results that had been obtained, it may be wondered why the Scripps Foundation began to work in this field at that time. It should be emphasized that we had no feeling of possessing superior prophetic power. We did not expect to prepare more accurate estimates than some of those already available, but did believe we could present much valuable material in addition to the customary figures of total population. For example, a growing demand was being manifested for information regarding probable changes in the makeup of the population in years to come. Furthermore, it seemed worth while to obtain data showing the effect on population growth and composition of differences in future trends of birth rates, death rates, and immigration—differences that seemed reasonable in view of past trends and present conditions in the United States and other nations.

The method we developed was based on a consideration of births, deaths, immigration, and emigration by age periods.<sup>1</sup> It was necessary to consider native-born whites, foreign-born whites, Negroes, and other colored by sex in order to secure the detailed data desired regarding the future composition of the population. Using various trends of birth rates, death rates, and migration by nativity, age and sex showed the effect on future growth and composition of differences in these factors and permitted the reader to choose the results of the combination that

\* Revision of a paper read before a joint meeting of the Population Association of America and the American Statistical Association, New York City, December 31, 1935.

<sup>1</sup> Although the method followed was worked out independently, much of it was found afterward to have been used by Bowley, A. L.: "Births and Population of Great Britain," *The Journal of the Royal Economic Society*, vol. 34 (1924), pp. 188-192.



seemed most reasonable to him rather than confining him to the current choice of the writers.<sup>2</sup> This paper will be confined to the procedure used in the calculations recently completed for the National Resources Committee, which differs in minor respects from that used previously.

#### ADJUSTING CENSUS DATA

The population according to the last census being taken as the starting point, the first step was to adjust for the underenumeration of children, separating whites and Negroes by sex. Taking registered births in the registration states from April 1, 1925 to April 1, 1927 and deducting deaths of this group up to April 1, 1930 gave an estimated number of survivors aged 3 and 4 on the latter date. After adjusting for interstate migration<sup>3</sup> these data were divided by the number of children enumerated. States with quotients of 1.00 or more were assumed to have complete birth registration, fourteen<sup>4</sup> being used for whites, and five<sup>5</sup> for Negroes. It was assumed that multiplying the enumerated children three and four in any state by the weighted average of these quotients for the selected states allowed for underenumeration and gave the complete number of children of this age. On this basis adding death losses gave the corrected number of births from April 1, 1925 to April 1, 1927 which was divided into births registered to obtain the per cent registered. Allowing for a slight improvement from 1920 to 1930 the per cent of births registered by years from April 1, 1927 to April 1, 1930 was estimated. Dividing registered births by these percentages, and deducting death losses gave the complete num-

<sup>2</sup> Eighteen series of computations have been made recently, for the United States as a whole, in cooperation with the Population Committee of the National Resources Committee. Earlier series include 14 for the United States, two for divisions, and two for individual states; for those published see: Whelpton, P. K.: "Population in the United States, 1925-1975," *American Journal of Sociology*, vol. 34, no. 2 (September 1928), pp. 253-270, ———: "The Future Growth of the Population of the United States," in *Problems of Population*, (G. H. L. F. Pitt-Rivers ed.; London: Allen and Unwin, 1932); Thompson, Warren S., and Whelpton, P. K.: *Population Trends in the United States* (New York: McGraw-Hill Book Company, Inc., 1933), ———: "Estimates of Future Population by States," prepared for the National Resources Board, Washington, National Resources Board, December 1934, ———: "Estimates of Future Population by States," Oxford, Ohio, Scripps Foundation for Research in Population Problems (October 1935) (Mimeographed); U. S. National Resources Board: "Report on National Planning and Public Works," Washington, G.P.O., (December 1934), pp. 96-97 (Thompson, Warren S., and Whelpton, P. K.).

<sup>3</sup> The interstate migration of white and Negro women in the childbearing ages was estimated as follows: (1) Deduct from the 1930 census population of each state the net gain through foreign immigration estimated from data in annual reports of the Commissioner General of Immigration. (2) Calculate survival rates for the United States by dividing the 1930 census population in each five-year age period by the 1920 census population ten years younger. (3) Modify these by the ratio of state to United States survival rates shown by the Metropolitan Life Tables for 1929-31. (4) Apply these state rates to the 1920 state populations and adjust the sum of the 1930 survivors to equal the national total. (5) Deduct these figures from the 1930 census in (1) to obtain net gain or loss of women by interstate migration. (6) After testing several values for the fertility during the five years ending April 1, 1930 of women migrating during this period compared with those in the states receiving migrants, 75 per cent was chosen as the most probable ratio. (7) Calculate the number of births to migrating women on this basis, deduct death losses, and raise or lower accordingly the number of children in each state.

<sup>4</sup> New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Michigan, Minnesota, Maryland, District of Columbia, Florida, Oregon, and California.

<sup>5</sup> New York, New Jersey, Pennsylvania, Illinois, and District of Columbia.

ber of children under three as of April 1, 1930. Dividing the complete number of children under five by the census number gave the correction constant for underenumeration, namely 1.05 for whites and 1.13 for Negroes, the latter value also being used for other colored children.

#### DEATH RATES AND TRENDS

An examination of birth and death data by age indicated that little if any increased accuracy would be obtained by dealing with one-year age periods and time intervals instead of five-year and that the additional labor involved would not be justified. The procedure adopted was to compute death rates by five-year age periods and time intervals for native whites, foreign-born whites<sup>6</sup> and Negroes by sex, and subtract these from unity to obtain survival rates by five-year age periods and time intervals, e.g., the number of native white women living to be 15-19 on April 1, 1935 out of 1,000 who were 10-14 on April 1, 1930. The steps in detail for the population in the 1930 death registration states are as follows: (1) Estimate the deaths for each race and nativity group from April 1 to December 31, 1930 and January 1 to March 31, 1935 on the assumption that the seasonal variation in deaths at all ages applies to deaths at each age. (2) For each calendar year or fraction thereof from April 1, 1930 to March 31, 1935, draw summation curves based on deaths by age at death,<sup>7</sup> and read deaths by age on April 1, 1930, e.g., persons dying between the ages of 43½ and 48½ in 1933 were between 40 and 45 on April 1, 1930. (3) Add deaths from April 1, 1930 to March 31, 1935 by age of persons on the former date. (4) Divide these sums by the number of persons (in thousands) enumerated by the census, except that deaths of children born from April 1, 1930 to March 31, 1935 are divided by the number of births<sup>8</sup> (in thousands) during that time interval. (5) Subtract these five-year-age-period-five-year-time-interval death rates from 1,000 to obtain five-year-age-period-five-year-time-interval survival rates. The death rates for native white males are shown in Table I. Because the death registration states of 1930 contained such a large proportion of the nation's population<sup>9</sup> it was assumed that the age specific rates of this area in 1930-34 represented those of the United States.

With five-year-age-period-five-year-time-interval survival rates obtained according to mortality conditions of 1930-34 the next problem was to determine the changes that would be likely to occur in them

<sup>6</sup> The Division of Vital Statistics did not classify white deaths by nativity after 1932, hence it was necessary to estimate their distribution for later years according to data for prior years.

<sup>7</sup> Special age class is set up for persons born between April 1, 1930 and March 31, 1935.

<sup>8</sup> Registered births plus estimated number not registered (see preceding section).

<sup>9</sup> 95.6 per cent of the native whites, 99.3 per cent of the foreign-born whites, and 92.8 per cent of the Negroes in 1930.

TABLE I

FIVE-YEAR-AGE-PERIOD-FIVE-YEAR-TIME-INTERVAL DEATH RATES FOR WHITE OR NATIVE WHITE MALES, 1900-02 TO 1930-34, AND ASSUMPTIONS FOR 1940-44 TO 1980

Time Interval	Birth to 0-4	0-4 to 5-9	10-14 to 15-19	20-24 to 25-29	30-34 to 35-39	40-44 to 45-49	50-54 to 55-59	60-64 to 65-69	70-74 to 75-79	80-84 to 85-89
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## White Males in the Original Registration States\*

1900-02	156.5	53.2	16.6	34.4	45.0	60.6	98.4	185.1	357.4	631.9
1909-11	142.1	42.3	14.2	27.4	40.7	60.4	100.3	194.8	370.2	632.2
1919-20	106.2	34.0	15.0	26.8	35.8	48.8	87.5	174.7	354.9	628.0
1929-31	71.5	19.2	10.1	16.7	24.3	46.9	93.8	186.4	362.6	627.5

## White Males in the 1920 Death Registration States\*

1919-21	92.7	28.9	14.2	24.5	32.5	44.6	78.4	160.0	335.7	660.0
1929-31	70.1	18.7	10.3	17.8	24.7	45.2	87.3	176.2	351.3	618.1

## White Males in the United States\*

1929-31	70.2	18.9	10.3	18.2	24.8	44.6	85.6	174.0	348.7	617.2
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## Native White Males in the United States

1930-34†	65.1	16.2	9.3	15.7	23.1	40.3	77.7	163.8	343.6	605.5
High‡										
1940-44	52.3	12.5	8.1	13.4	20.1	37.2	74.7	160.5	340.1	601.8
1950-54	45.3	10.9	7.8	12.3	18.2	33.9	69.7	153.7	334.3	598.4
1960-64	41.2	10.3	7.6	11.6	17.0	31.1	64.5	144.1	325.9	595.6
1970-74	39.9	9.9	7.4	11.4	16.2	29.6	62.0	135.4	319.5	594.1
1980-	39.7	9.8	7.4	11.4	16.0	29.2	61.2	133.0	318.2	593.8
Medium‡										
1940-44	50.0	12.2	7.7	12.3	18.2	35.1	72.1	157.1	331.4	601.8
1950-54	41.7	10.5	7.2	10.5	15.1	29.6	62.6	143.1	311.0	598.4
1960-64	36.9	9.7	7.0	9.5	13.0	25.0	52.4	123.1	281.5	595.6
1970-74	35.2	9.3	6.8	9.1	11.8	22.5	47.5	105.0	259.2	594.1
1980-	35.0	9.2	6.8	9.0	11.5	21.9	45.9	99.8	254.6	593.8
Low‡										
1940-44	48.5	11.9	7.4	11.6	17.4	33.0	69.3	153.5	322.6	601.8
1950-54	39.3	10.0	6.8	9.5	13.8	25.4	55.2	132.2	287.7	598.4
1960-64	34.0	9.2	6.5	8.3	11.4	19.0	40.2	101.8	237.1	595.6
1970-74	32.2	8.8	6.3	7.9	10.0	15.5	32.9	74.3	198.8	594.1
1980-	32.0	8.7	6.3	7.8	9.7	14.6	30.6	66.5	190.9	593.8

## Males in New Zealand

1901-05‡	91.3	22.9	11.2	20.2	26.1	41.0	74.6	150.9	340.5	601.9
1931	42.6	10.2	7.9	13.0	17.7	29.2	61.2	133.0	318.2	593.8

## United States Rates for 1980 in Per Cent of New Zealand Rates for 1931

High	75.0	85.0	80.0	60.0	55.0	50.0	50.0	50.0	60.0	100.0
Medium	82.2	90.2	88.1	69.2	65.0	75.0	75.0	75.0	80.0	100.0
Low	93.2	96.1	93.7	87.7	90.4	100.0	100.0	100.0	100.0	100.0

\* Computed from Official Life Tables of the Bureau of the Census. Mexicans are included with whites.

† Computed by the Scripps Foundation for Research in Population Problems according to method outlined in text. Mexicans not included.

‡ See text for basis of assumptions.

§ Computed from life table in New Zealand Official Year Book, 1914, p. 938. For the total population (excluding aborigines) which includes few colored persons.

|| Computed from life table of Louis I. Dublin and Alfred J. Lotka of the Metropolitan Life Insurance Company.

during future years. Past trends in death rates and life expectancy were wanted as one guide, and were obtained from data in various life tables, extending back to 1900-02 for the original death registration states and to 1789 for Massachusetts.<sup>10</sup> The outstanding facts are the large decreases in death rates occurring at younger ages and the small decreases or occasional increases at older ages. In Massachusetts from 1789 to 1930, 25 years were added to the expectation of life at birth, 13 years at age 20, and 4 years at age 40, but there was no significant improvement at ages above 60. Changes in age specific death rates and expectation of life for the white population of the original registration states from 1900-02 to 1929-31 have been similar to those for Massachusetts. The death rate of white males from birth to 0-4 declined over 50 per cent and from 0-4 to 5-9 nearly 65 per cent. As age increased beyond 5-9 declines rapidly became smaller, amounting to less than 25 per cent at age 40-44 and being negligible at ages over 60 (Table I). Life table data for Negroes have been much less adequate than for whites, and do not go back of 1900. In the original registration states from 1900 to 1920 the expectation of life at birth increased more for Negroes than whites, but little if any improvement occurred in the age periods over 20 as a whole. The more recent trend for Negroes has been downward. Between 1920 and 1930 the life expectancy of males in the 1920 registration states decreased considerably at most ages and that of females increased at the younger ages but declined somewhat between 20 and 75.

As a second guide in determining the future death rates to be used in these calculations it seemed appropriate to study the country with the world's most favorable mortality conditions, namely, New Zealand. Past trends there have been similar to those in the United States, but more progress has been made in lowering death rates at ages below 65 and especially in the 40's and below 10 (Table I). Death losses apparently have been slightly higher than in the United States at ages above 85, but the numbers involved are small, and differences in accuracy of reporting age at death or on the census date may account for part of the excess.

A third type of information, not statistical but helpful nevertheless, comes from the fields of medicine and public health. There is no question but that all the knowledge now available about controlling various causes of death is not being put into practice to the extent that it will be in the future. Furthermore, it is almost inconceivable that additions to this fund of knowledge are suddenly going to cease. To be more

<sup>10</sup> For a summary of these life tables see Thompson, Warren S., and Whelpton, P. K.: *Population Trends in the United States*, p. 240.

specific on the first point, the various serums recently developed for pneumonia are almost certain to come into common use in the future, and lower markedly the death rate from this disease. Likewise the near future should see the inauguration of a public health campaign against syphilis which will produce results comparable to those obtained in the fight against tuberculosis.<sup>11</sup> There is less basis for being dogmatic on the second point, but medical research is sure to continue, and can be counted on to yield valuable information as it has in the past.

Although the foregoing type of information on death rates and their control is helpful in indicating future trends it does not show precisely the course which will be followed, except to those who have implicit faith in the results obtained by extrapolating a time series according to a particular formula. After examining the evidence most people probably would agree in expecting substantial declines from 1935 to 1980 in death rates at ages below 35, but would differ as to the exact amount of these declines. The rapid downward trend of recent decades cannot continue for long without bringing the rates almost to zero, which even the most optimistic do not expect. On the other hand a comparison of United States and New Zealand trends should lead the pessimistic to expect 1980 rates here to be at least as low as present rates there. Opinions probably will vary more widely as to the course of death rates at ages 50 to 75. To the pessimistic the slight downward trend in the United States and the small favorable differential of New Zealand do not point to large future gains. But the optimistic will argue that attention is being centered increasingly on diseases that exact a heavy toll at these ages, and that such causes as cancer, syphilis, and diseases of the heart may eventually be brought under control just as is occurring with pneumonia at the present time. All can agree that unless death rates in middle life are lowered substantially there can not be large gains in the expectation of life at birth. Death rates of native whites at ages under 25 are so low already that if none died before that age and 1930-34 death rates at older ages continued as at present the expectation of life at birth would only be raised from 62.4 to 68.7.

After considering the facts that could be brought together three trends were laid out for native white death rates up to 1980. According to the least favorable assumption—with highest death rates—the expectation of life at birth will be raised from 62.4 in 1930-34 to 67 in 1980,<sup>12</sup> through death rates declining somewhat below 1931 New Zea-

<sup>11</sup> Parran, Thomas: "The Next Great Plague to Go," *Survey Graphic*, vol. 25, no. 7 (July 1936), pp. 405-411; 442-443.

<sup>12</sup> Males and females combined, with male death rates declining slightly more than female death rates at most ages.

land rates at ages below 40, and as low as those rates at older ages (see Table I). The most favorable assumption—with lowest death rates—envisaged somewhat greater improvement in mortality conditions at the younger ages and much more at middle life, with the expectation of life rising to 73 in 1980. The medium trend, which now seems most probable to us, lengthened life expectancy at birth to 70 years, keeping death rates at younger ages nearer the low than the high assumptions, and at older ages about midway between the two. Death rate trends for foreign-born whites, Negroes, and other colored were assumed to be similar to those for native whites, but with slightly larger decreases. The unfavorable differential of these groups compared with native whites was diminished by one-fourth in the high death rate trends, one-half in the medium, and three-fourths in the low.

#### BIRTH RATE TRENDS

For births as for deaths it was desired to have rates for five-year age periods and time intervals in making the actual computations. Because of the necessity of using ratios of children to women in determining long-time trends of United States birth rates in the past it was decided to use the methodology of the former and divide births during a five-year interval by women living at the end of the interval.

To obtain rates for the base period, births registered from April 1, 1930 to March 31, 1935 in the 1930 registration states were increased to allow for nonregistration, white births<sup>13</sup> being divided by .96<sup>14</sup> and colored births by .86. Using summation curves, the grouping of births by age, color and nativity of mother was changed from age at birth of child to age on April 1, 1935. The number of women in the 1930 birth registration states on this later date was calculated by multiplying the number enumerated in the 1930 census by the five-year-age-period-five-year-time-interval survival rates described above. Dividing births to native and foreign-born white women by the number of women in the proper year and age periods gave preliminary rates for the 1930 birth registration states. Since these states contained 95 per cent of the nation's native white population in 1930 these native white rates were used for the United States (see Table II).

To obtain rates for the other groups several minor adjustments were necessary. Births to Negro women not being published by age of mother it was assumed that their percentage distribution by age of mother was the same as that for colored births, which were 90.2 per

<sup>13</sup> Mexican births were estimated in a few states where they are wholly or partially registered as white, and transferred from white to colored mothers.

<sup>14</sup> These values were obtained in computing the underenumeration of children under five shown above.

cent Negro in 1930-34. Dividing these births by the survivors from the 1930 Negro female population in the birth registration states gave rates for this area. The number of births to Negro women in the United States during 1930-34 was then estimated from the census ratio of Negro children under 1 in the 1930 birth registration states to those in the United States, and a similar ratio based on Negro births during 1933-34. Finally, rates for the birth registration states were adjusted proportionally so that when applied to the survivors from the United States Negro female population of April 1, 1930 they would give this number of births. These rates appear in Table II.

TABLE II  
BIRTHS FROM APRIL 1, 1930 TO APRIL 1, 1935 PER 1,000 WOMEN BY  
AGE ON LATER DATE\*

Nativity and Race	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Σ
Native White Women	65.1	432.1	592.7	509.5	342.1	186.3	49.6	2,177.4
Foreign-born White Women	44.5	490.8	703.3	550.3	389.2	200.0	55.5	2,433.6
Negro Women	174.8	786.4	636.5	471.1	407.4	206.5	67.3	2,750.1
Other Colored Women	266.5	1,199.1	970.4	718.3	621.1	314.9	102.6	4,192.8

\* Computed according to method outlined in text.

In the case of foreign-born white and other colored women and their children under 5 it was necessary to consider immigration. The net movement in the five years beginning April 1, 1930 by five-year age periods as of April 1, 1935 was estimated from official data on age of migrants. Arrivals exceeded departures for foreign-born white women up to age 35, but departures exceeded arrivals at older ages, and for other colored women at all ages.<sup>15</sup> For the whites it was desired to deal with women in the United States on April 1, 1930 and births to them both here and abroad. To do this it was assumed that women migrating between April 1, 1930 and April 1, 1935 had the same number of births during this interval in the United States as in foreign countries, or twice the number represented by migrating children 0-4. Births in the United States to foreign-born white women were estimated from births in the 1930 registration states, assuming the 1930-34 relation-

<sup>15</sup> The net movement of women and their children was estimated as follows:

	Children 0-4	Women						
		15-19	20-24	25-29	30-34	35-39	40-44	45-49
Foreign-born White Women	-15,300	7,000	11,800	14,600	400	-1,100	-800	-1,000
Other Colored Women	-800	-1,700	-2,600	-4,500	-4,600	-4,000	-3,300	-2,500

ship to be the same as that known for 1933. These local births were increased by 18,300 births abroad to recent emigrant women and decreased by 1,100 births in the United States to recent immigrant women,<sup>16</sup> and final specific birth rates obtained by adjusting the temporary foreign-born white rates so they would yield this number of births when applied to the survivors on April 1, 1935 of the foreign-born white females enumerated five years earlier (see Table II). In a similar manner, other colored births in the United States were estimated from births in the 1930 registration states, and decreased by 900 to allow for births in the United States during 1930-34 to women emigrating in that interval. Because of the large margin of error in these data for other colored, age specific birth rates were not computed for this group. Instead, those for Negroes were changed proportionally to yield the number of other colored births mentioned above when applied to the survivors on April 1, 1935 of the other colored females enumerated five years earlier minus the net emigration during this time (see Table II).

Since it is not customary to use five-year-age-period-five-year-time-interval birth rates or their sum a brief interpretation may be helpful. The sum of these rates is approximately equal numerically to the sum of annual rates by one-year age periods or five times the sum of annual rates by five-year age periods, the total fertility of Kuczynski.<sup>17</sup> For example, the sum of the five-year-age-period-five-year-time-interval rates and the total fertility rates in the United States during 1930-34 were as follows: native whites, 2,177 and 2,158; foreign-born whites, 2,434 and 2,404; and Negroes, 2,750 and 2,728. The sum of the five-year-age-period-five-year-time-interval rates also indicates approximately the number of births per 1,000 women living to age 50.<sup>18</sup> For native whites this amounts to 2,177, which is equivalent to 2,432 births per 1,000 married women<sup>19</sup> since the last census shows only 10.5 per cent remaining single at age 50. The fragmentary evidence available indicates that about one-sixth of the women who marry are infertile, i.e., bear no children, so the rate per 1,000 fertile women would rise approximately to 2,920, or nearly 3 births to each fertile woman.

Choosing trends which these five-year-age-period-five-year-time-interval birth rates might be expected to follow in the United States dur-

<sup>16</sup> Estimated from 17,400 native born children under 5 on April 1, 1935 permanently departing (most of whom had foreign-born mothers) and the net arrivals of 1,100 foreign-born children under 5.

<sup>17</sup> Kuczynski, R. R.: *The Measurement of Population Growth* (London: Sidgwick & Jackson, 1935), p. 117.

<sup>18</sup> In adding the five-year-age-period-five-year-time-interval rates it is assumed that the fertility at any age of life is the same for women who will die before the menopause as for those who will live through it, which probably is not far from the truth. Fertility and mortality probably are inversely related, other things equal. But actually other things are not equal since both fertility and mortality are inversely correlated with economic status.

<sup>19</sup> Assuming that all single women bearing children marry later on.



ing future years presented more difficulties than the similar choice for death rate trends. Although the experience of foreign countries probably is less helpful in this case than the other, it was believed to merit attention. For this purpose total fertility rates calculated for many foreign countries by Kuczynski<sup>20</sup> were compared with those for the United States. Low as the recent rate of 2,158 is for native whites in the United States, rates for Australia and New Zealand are almost identical (2,195 and 2,151), while those for all the Western European countries and two of the Eastern (Austria and Latvia) are even lower.<sup>21</sup> Wherever the immediate post-war rates and the recent rates can be compared a striking drop is shown, in most cases continuing a slower decline that was going on before the war. Judging from what has happened in other nations, therefore, there is little basis for expecting the downward trend in the United States to end suddenly and a rise to set in. It is true that crude birth rates in several countries (including the United States) were slightly higher in 1934 than in 1933, but reports for 1935 and current months of 1936 indicate that the rise is not continuing, and that neither 1935 nor 1936 rates will equal the 1930-34 average with the possible exception of Germany.

In addition to this international comparison the long-time trend in the United States during past years was desired before making assumptions regarding the future. Because the birth registration area was not organized until 1915 it was necessary to estimate this from census data. The procedure followed was to approximate the number of births in the five years ending on the census date by adjusting children under five for underenumeration, and adding an allowance for death losses. Birth rates by five-year age periods for 1930-34 (Table II) were then adjusted proportionally so that when multiplied by the proper groups of women in earlier censuses the sum of the products would equal the above estimate of births.<sup>22</sup> Implicit in this process is the assumption that the percentage variation in age specific birth rates in the past was the same at all ages. It is almost certain that such was not the case, and that there was a direct relation between age and percentage decrease prior to 1915 as there has been since that time. Nevertheless, lack of data for estimating the differences in trend by age, together with the fact that the same figures for total births would be obtained in any event, appeared to justify this procedure.

<sup>20</sup> Kuczynski, R. R.: *op. cit.*, pp. 122-124.

<sup>21</sup> Denmark 2,413, England 1,504, France 2,240, Germany 1,778, Sweden 1,878, Austria 1,787, Latvia 2,212. The rates for Denmark, France, and Latvia are for years between 1926 and 1930, and do not show the decline which occurred after 1930.

<sup>22</sup> To illustrate: rates for native white women in the 1910 census were obtained by multiplying these women by the 1930-34 rates, dividing the resulting births into the estimate of births to these women during the five years prior to the 1910 census, and multiplying the 1930-34 rates by this quotient.

As would be expected from earlier studies of ratios of children to women,<sup>23</sup> these estimates show there has been a large and almost uninterrupted decline of age specific birth rates since the beginning of the nineteenth century. White rates during 1875-79 were more than twice as large as those during 1930-34, while during 1795-99 they were over  $3\frac{1}{2}$  times as large (see Table III). In only one ten-year interval does there appear to have been an increase in these rates (from 1845-49 to 1855-59) every other ten-year interval showing a decided decrease. Although the numerical declines have become smaller as the rates have become lower, the percentage declines in ten years have shown little tendency to diminish, the 18 per cent drop from 1915-19 to 1925-29 being the largest in the series, and the 17 per cent drop in the *five-year* interval from 1925-29 to 1930-34 being nearly as large.

Similar rates for native and foreign-born white women cannot be estimated accurately prior to 1905-09, nor for Negro women prior to 1845-49. Since these dates the decline of native white rates has been somewhat less than that of all whites, that of Negro rates about the same (although concentrated in different decades) and that of foreign-born white rates much more rapid.

Because birth rates are more subject to human control than death rates there is less basis for predicting their future course by extrapolating the local trend during past years, or by accepting the present situation in some foreign countries as the goal that will be reached here at some future time. Recent studies indicate that the practice of contraception is an exceedingly important immediate factor governing the size of the birth rate.<sup>24</sup> Judging from the improvements in the technique of contraception and the wider diffusion through the population of information regarding birth control that have taken place in the last decade or two further declines in birth rates are to be expected. However, a wide number of conditions govern the extent to which birth control is practiced by those acquainted with the methods, and little is known about how or to what degree they may be influenced. As a consequence of the legitimate differences in opinions regarding what is ahead it seems desirable to calculate the future population according to more divergent assumptions of trends of birth rates than of death rates.

<sup>23</sup> Wilcox, Walter F.: *Proportion of Children in the United States*, Washington, G.P.O. (1905). Bull. 22.

\_\_\_\_\_: "The Change in the Proportion of Children in the United States and in the Birth Rate in France during the Nineteenth Century," *American Statistical Association Publications*, vol. 12, n.s. no. 93 (March 1911), pp. 490-499.

Whelpton, P. K.: "Industrial Development and Population Growth," *Social Forces*, vol. 6, nos. 3-4 (March-June 1928), pp. 458-467; 629-638.

<sup>24</sup> Pearl, Raymond: "Contraception and Fertility in 4945 Married Women. A Study of Family Limitation," *Human Biology*, vol. 6, no. 2 (May 1934), pp. 355-401.

Stix, Regine K., and Frank W. Notestein: "Effectiveness of Birth Control," *Quarterly Bulletin of the Milbank Memorial Fund*, vol. 13, no. 2 (April 1935), pp. 162-178.

Careful consideration of the information available regarding birth rates and factors affecting them lead us to adopt as the high birth rate assumption an abrupt stopping of the past decline, and a continuation of the 1930-34 values during subsequent years. For the low assump-

TABLE III  
BIRTH RATES PER 1,000 WOMEN IN THE UNITED STATES 1930-34, WITH ESTIMATES FOR EARLIER YEARS AND ASSUMPTIONS FOR LATER YEARS, BY COLOR AND NATIVITY\*

Year	All White Women†		Native Born White Women†		Foreign-born White Women†		Negro Women		Other Colored Women	
	Birth Rate	Percent of 1930-34	Rate Birth	Percent of 1930-34	Rate Birth	Percent of 1930-34	Rate Birth	Percent of 1930-34	Birth Rate	Percent of 1930-34
1789-99	7844	356.1								
1805-09	7798	354.1								
1815-19	7416	336.7								
1825-29	7050	320.1								
1835-39	6607	302.7								
1845-49	5473	248.5					6857	249.3		
1855-59	5536	251.3					6725	244.5		
1865-69	4968	225.6					6239	226.9		
1875-79	4686	212.8					6689	243.2		
1885-89	4042	183.5					5525	200.9		
1895-99	3846	174.6					4867	177.0		
1905-09	3510	159.3	3281	150.7	4510	185.3	4118	149.7		
1915-19	3244	147.3	2961	136.0	4669	191.9	3226	117.3		
1925-29	2650	120.3	2597	119.3	3012	123.8	2855	103.8		
1930-34	2202	100.0	2177	100.0	2434	100.0	2750	100.0	4193	100.0
Low‡										
1935-39	1954	88.7	1940	89.1	2152	88.4	2431	88.4	3635	86.7
1945-49	1685	76.5	1682	77.2	1839	75.6	2066	75.1	2976	71.0
1955-59	1566	71.1	1566	71.9	1692	69.5	1883	68.5	2619	62.5
1965-69	1520	69.0	1520	69.8	1625	66.8	1788	65.0	2407	57.4
1975-79	1503	68.2	1503	69.0	1593	65.5	1733	63.0	2262	54.0
Medium§										
1935-39	2092	95.0	2077	95.4	2314	95.1	2614	95.1	3953	94.3
1945-49	1975	89.7	1969	90.4	2180	89.6	2456	89.3	3655	87.2
1955-59	1932	87.7	1928	88.5	2122	87.2	2379	86.5	3486	83.1
1965-69	1912	86.8	1908	87.6	2089	85.9	2330	84.7	3362	80.2
1975-79	1905	86.5	1901	87.3	2071	85.1	2297	83.5	3264	77.8
High										
1935-79	¶		2177	100.0	2434	100.0	2750	100.0	4193	100.0

\* The 1930-34 rates are sums of rates by five-year age periods in Table II. See text for method of estimating rates for earlier years and assumptions for subsequent years.

† Mexicans are included with whites up to 1915-19 and excluded in 1925-29 and later years in accordance with current census practice.

‡ Assuming no immigration.

§ Assuming net immigration of 100,000 per year.

|| Assuming net immigration of 200,000 per year.

¶ Since the birth rates of native white and foreign-born white women remain unchanged the rate for total whites varies only as there are changes in the proportion of native and foreign-born whites. Starting from 2,202 in 1930-34 the rates for future years are as follows: 1935-39; 2,194; 1945-49, 2,186; 1955-59, 2,187; 1965-69, 2,188; and 1975-79 also 2,188.

tion, the past downward trend was continued at a decreasing pace, rates for native whites reaching a level in 1980 at 1,500 births per 1,000 women living through the childbearing period compared with 2,177 during 1930-34 (see Table III). This represents a decline of 31 per cent from 1930-34 to 1980 as compared with 34 per cent from 1905-09 to 1930-34. The 1980 rate is approximately that of England

in 1933, and only a little under that of California and Washington, D.C., in 1929-31. It would be attained if nine-tenths of the women living to age 50 marry and one-sixth of those marrying bear no children as at present, and if the remainder are equally divided into those bearing 1, 2, and 3 children.

For the medium assumption the past downward trend was continued at a slower pace, reaching a level in 1980 at 1,900 births per 1,000 native white women living through the childbearing period. This rate would prevail if present rates for marriage and infertility of married women continued, and if fertile women were about equally divided between those bearing 1, 2, 3, and 4 children. It would represent a decline in rate of 12.7 per cent in the next fifty years compared with a 34 per cent drop in the last 25 years. The United States rate in 1980 would be approximately that of Sweden, and also of Massachusetts, Connecticut, Washington, and Oregon in 1929-31, and significantly higher than the rate of New York and New Jersey. In the low assumption the 1930-34 differentials between native whites and other groups were reduced by 50 per cent, in the medium by 25 per cent.

#### IMMIGRATION ASSUMPTIONS

Future trends of birth and death rates may have some relation to past trends, but those for immigration are almost certain to be unrelated. Formerly there was little governmental control exercised over immigration, hence the size of the movement varied chiefly with economic conditions here and abroad. Since the World War, however, the attitude has changed greatly. In response to public opinion in this country laws and regulations have been adopted which limit rigorously the number of immigrants admitted. At the same time certain foreign countries which formerly sent millions of persons, e.g., Italy, have developed nationalistic policies which have led to discouraging and even prohibiting emigration to foreign countries. What will happen in the future, therefore, depends primarily on political action, which may be influenced by a great variety of conditions. Under these circumstances the desirable procedure in these calculations seems to be to show the future population according to several assumptions of future birth and death rate trends with no immigration and also with net arrivals of 100,000 or 200,000 annually beginning 1940.<sup>28</sup> By utilizing differences between the with and without immigration series those interested in the effect of movements of larger or smaller numbers may easily obtain the results they wish. In all cases the relative color and age composition

<sup>28</sup> To simplify the calculations the net additions every five years were taken as five times these values (with no allowance for deaths) and the number of native born children 0-4 was increased by an amount equal to the immigrants of that age.

of the immigrants is assumed to be approximately the same as of those entering during 1925-29, but a sex ratio of 122.22 for whites and 150 for other colored is used as being more normal than the excess of females in the actual movement of those years.

#### THE FUTURE POPULATION

If the three assumptions for the future course of birth rates and three for death rates that have been described are combined in all possible ways with and without immigration, 18 series showing the future population of the United States will be obtained. Only 6 will be shown, the extremes and the middle ground with and without immigration<sup>26</sup> (Table IV). *A* will be referred to as the low series, *D*

TABLE IV  
FUTURE POPULATION OF THE UNITED STATES IF FERTILITY, MORTALITY, AND  
IMMIGRATION FOLLOW STATED TRENDS 1935 TO 1980\*  
(Thousands)

Year	Low Fertility High Mortality		Medium Fertility Medium Mortality		High Fertility Low Mortality	
	No Immigration <i>A</i>	100,000† Immigrants <i>B</i>	No Immigration <i>C</i>	100,000† Immigrants <i>D</i>	No Immigration <i>E</i>	200,000† Immigrants <i>F</i>
1930‡	122,775.1	122,775.1	122,775.1	122,775.1	122,775.1	122,775.1
1935	127,354.3	127,354.3	127,354.3	127,354.3	127,354.3	127,354.3
1940	131,157.0	131,157.0	131,993.1	131,993.1	132,613.2	132,613.2
1945	134,138.7	134,647.9	136,447.4	136,956.6	138,209.7	139,228.4
1950	136,176.6	137,245.7	140,580.9	141,644.8	143,898.4	146,086.2
1955	137,171.9	138,840.3	144,093.1	145,808.1	149,353.0	152,852.1
1960	137,088.7	139,375.3	146,986.5	149,371.6	154,563.5	159,481.2
1965	136,026.3	138,938.0	149,340.8	152,421.2	159,719.5	166,135.2
1970	134,048.9	137,588.3	151,170.0	154,969.3	164,835.8	172,837.0
1975	131,221.1	135,387.4	152,432.9	156,977.4	169,779.0	179,471.1
1980	127,570.9	132,356.7	153,022.3	158,335.2	174,330.3	185,823.5

\* See text for description of trends assumed. The calculated numbers of children 0-4 and hence of total persons are reduced to correspond with underenumeration of children in the census.

† Net annually, beginning with 1940.

‡ Census.

as the medium, and *F* as the high. According to the low series the population will cease to grow between 1955 and 1960, and from then to 1980 will decline at an accelerated pace. Its maximum size will be about 137,300,000 and by 1980 it will be back to the 1935 figure (Table IV). If the high series is followed growth will continue until after 1980, although at a decreasing rate, and the population on that date will amount to about 185,800,000. At the present time it seems to us that the medium series will be closer to what happens than the high or low, though probably somewhat too high. According to this

\* In all cases immigration is assumed to begin in 1940.

series, the population will reach its maximum of about 160,000,000 soon after 1980, and then begin to dwindle numerically.

Some of the changes in composition that will come about if population growth follows the medium series are shown in Table V. Native whites will make up an increasing proportion of the total, but there will be a larger decrease in the proportion of foreign-born whites. Negroes will make a small relative gain and other colored a large one, though they will still constitute less than 4 per cent of the total. The sexes will become more nearly balanced in numbers as time passes, the native white sex ratio remaining almost unchanged at 101 but that for foreign-

TABLE V  
FUTURE POPULATION OF THE UNITED STATES ACCORDING TO MEDIUM SERIES\*  
BY COLOR, NATIVITY, AND SEX, 1935 TO 1980  
(Thousands)

Year	Total Population		Native White		Foreign-born White		Negro		Other Colored	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1930†	62,137.1	60,638.0	48,010.1	47,487.7	7,153.7	6,212.7	5,855.7	6,035.5	1,117.6	902.1
1935	64,141.4	63,212.9	50,566.3	50,200.3	6,304.3	5,691.7	6,153.7	6,360.6	1,117.1	960.3
1940	66,296.0	65,697.1	53,048.3	52,822.0	5,586.3	5,129.5	6,455.3	6,683.1	1,206.1	1,062.5
1945	68,667.6	68,289.0	55,439.5	55,320.6	5,087.5	4,737.0	6,763.4	7,004.8	1,377.2	1,226.6
1950	70,935.7	70,709.1	57,689.7	57,636.0	4,598.4	4,336.1	7,072.8	7,319.9	1,574.8	1,417.1
1955	72,979.4	72,828.7	59,671.5	59,639.0	4,135.0	3,937.6	7,386.4	7,631.5	1,786.5	1,620.6
1960	74,762.3	74,609.3	61,339.3	61,283.7	3,707.1	3,550.2	7,703.5	7,938.4	2,012.4	1,837.0
1965	76,327.8	76,093.4	62,726.9	62,601.7	3,322.0	3,181.0	8,022.4	8,239.5	2,256.5	2,071.2
1970	77,681.8	77,287.5	63,843.8	63,603.6	2,984.2	2,835.1	8,334.5	8,525.6	2,519.3	2,323.2
1975	78,798.2	78,179.2	64,664.9	64,276.3	2,703.4	2,521.5	8,631.6	8,789.9	2,798.3	2,591.5
1980	79,612.4	78,722.8	65,128.6	64,575.2	2,492.1	2,252.6	8,900.6	9,022.0	3,091.1	2,873.0

\* Medium fertility and mortality trends described in text, and net immigration of 100,000 annually beginning in 1940. The calculated numbers of children 0-4 and hence of total persons are reduced to correspond with underenumeration of children in the census.

† Census.

born whites declining from 115 in 1930 to 111 in 1980, that for Negroes rising from 97 to 99, and that for other colored declining from 124 to 108.

The aging of the population that will occur according to the medium series is shown in Table VI. Never again will there be as many children under 15 as in 1935, the number of this age in 1980 being 4,391,200 less than now. The 15-19 age period will reach a maximum in 1940, and the 20-24 in 1945, both being smaller in 1980 than now. At ages 25 to 54 the 1980 population will outnumber the present, though as at younger ages the peak will have occurred previously. This peak in each five-year period, by the way, is composed of those born during 1920-24, the five years with the most births in the history of the nation. Survivors from these births can be traced easily across Table VI, and as late as 1975 are more numerous than those in any other age period in spite of the death losses that have occurred. At ages above 55 the number of persons increases steadily to 1980, and on the whole with a rising

TABLE VI  
FUTURE POPULATION OF THE UNITED STATES ACCORDING TO MEDIUM SERIES\* BY AGE, 1935 TO 1980  
(Thousands)

Age Period	1930†	1935	1940	1945	1950	1955	1960	1965	1970	1975	1980
0-4‡	12,143.2	10,911.8	11,081.3	11,216.2	11,280.7	11,050.2	10,755.7	10,558.7	10,453.9	10,388.8	10,305.3
5-9	12,617.4	11,836.0	10,764.3	10,919.8	11,113.1	11,184.7	10,961.4	10,672.8	10,479.7	10,377.6	10,314.2
10-14	12,014.0	12,823.2	11,963.0	10,737.7	10,895.2	11,088.7	11,161.2	10,940.1	10,653.1	10,441.9	10,360.3
15-19	11,861.0	11,910.9	12,424.8	11,940.2	10,726.8	10,885.6	11,079.5	11,123.7	10,934.1	10,649.5	10,469.3
20-24	10,878.8	11,367.3	11,769.9	12,421.4	11,852.2	10,757.4	10,918.8	11,113.5	11,187.1	10,971.6	10,690.5
25-29	9,841.2	10,668.3	11,218.5	11,712.7	12,378.8	11,827.2	10,752.5	10,918.0	11,112.8	11,187.6	10,975.1
30-34	9,271.3	9,581.8	10,466.1	11,091.0	11,596.0	12,266.0	11,732.8	10,678.3	10,847.4	11,043.7	11,119.5
35-39	7,213.8	8,845.7	9,360.0	10,274.0	10,907.6	11,422.6	12,095.7	11,581.2	10,550.4	10,722.7	10,918.8
40-44	7,047.7	8,561.3	8,592.0	9,122.7	10,039.7	10,682.4	11,206.0	11,878.0	11,381.2	10,372.2	10,543.7
45-49	7,047.7	7,619.8	8,523.3	8,283.9	8,820.4	9,736.9	10,389.8	10,925.2	11,568.1	11,122.6	10,140.3
50-54	5,980.3	6,614.9	7,206.2	8,095.8	7,900.3	8,442.1	9,359.2	10,024.9	10,566.4	11,230.1	10,777.3
55-59	5,949.2	5,490.8	6,110.9	6,690.1	7,555.0	7,421.5	7,974.3	8,890.7	9,554.1	10,092.0	10,737.2
60-64	5,764.0	4,119.9	4,888.0	5,468.0	6,023.0	6,849.3	6,781.5	7,338.9	8,239.5	8,906.2	9,436.6
65-69	2,772.5	3,151.9	3,483.3	4,148.7	4,666.4	5,195.0	5,972.6	5,983.5	6,543.2	7,408.3	8,045.4
70-74	1,961.5	2,133.0	2,444.6	2,721.7	3,273.9	3,734.0	4,222.2	4,938.4	5,025.3	5,566.3	6,323.3
75-79	1,107.3	1,312.3	1,450.3	1,878.9	1,891.0	2,312.2	2,686.2	3,068.2	3,687.7	3,794.8	4,218.0
80-84	535.2	601.4	722.6	807.9	1,061.6	1,067.3	1,375.6	1,637.1	1,914.9	2,295.7	2,372.6
85-89	205.7	216.7	245.8	296.9	332.9	393.6	455.0	572.9	683.6	800.2	962.7
90-94	51.6	57.2	61.5	69.9	84.3	94.7	112.1	129.6	164.1	196.6	229.9
95 plus	14.9	9.8	10.9	11.8	13.2	15.9	18.0	21.3	24.5	31.5	37.9
Total†	123,464.9	127,984.0	132,629.3	137,806.3	142,302.1	146,457.3	150,010.1	153,064.0	155,601.1	157,609.9	158,967.4
Compar- able to Census											
0-4	11,453.4	10,282.1	10,395.1	10,566.5	10,623.4	10,401.0	10,117.2	9,925.9	9,822.1	9,756.3	9,673.1
Total	122,776.1	127,354.3	131,993.1	136,956.6	141,644.8	145,808.1	149,371.6	152,431.2	154,969.3	156,977.4	158,335.2

\* Medium fertility and mortality trends described in text, and net immigration of 100,000 annually beginning in 1940.

† Census.

‡ Includes allowance for underenumeration of children 0-4 in the census explained in text.

rate as age goes up. Persons 50-59 will be twice as numerous in 1980 as now, but those over 80 will be over 4 times as numerous.

Making comparisons between 1935 and 1980 on a percentage basis, the proportion of children and youths (under 20) will decline almost one-third from 36.6 per cent to 25.8 per cent, the proportion in the best working ages (20-39) will decrease slightly from 31.8 per cent to 27.6 per cent, the middle age group (40-64) will have a relative rise of over one-fourth from 25.7 per cent to 32.6 per cent, and elders (65 and over) will more than double relatively, jumping from 5.9 per cent to 14 per cent. If persons in the first and last group are considered as dependents and those in the second and third as producers, the number of dependents per 100 producers will decline significantly, from 73.9 to 66.1. Even if the middle aged are counted only half as valuable from a production standpoint as those 20-39 the ratio of dependents to producers will still decline from 95.2 to 90.6.

If population growth follows the low series these changes in composition will be much more striking. But even if the high series is followed the makeup of the 1980 population will differ sufficiently from that of the present so that making adjustments to the new conditions may present serious difficulties.

Although much time and thought have been devoted to these empirical calculations of future population it is fully realized that this does not insure obtaining results which show accurately the growth and composition that will occur. It is hoped, however, that the undertaking is worth while because of the information it may contribute and the thinking it may stimulate regarding the relationship of birth rates, death rates, and immigration to the size and composition of the population in years to come, and also regarding the changes in growth and makeup which now appear probable and which will raise problems of great significance.



## THE APPLICATION OF SAMPLING TO ECONOMIC AND SOCIOLOGICAL PROBLEMS\*

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IT CAN hardly be expected that I should have anything new to say on the subject of sampling, since the methods were discussed at a recent meeting of the Statistical Society, since most of my theoretical work on the mathematical aspects of the question have been accessible to students for a long time, and since the results of the field investigations which I have directed or in which I have cooperated have been published.

The theory of sampling is almost co-extensive with the mathematical theory of probability, at least with that region which is covered in Whitworth's *Choice and Chance*. A universe is symbolized by an urn or a group of urns which contain numbers of balls differing only in colour; one or more selections are drawn in accordance with definite rules, and it is asked what is the relation between the proportions by colour in the selections and those in the universe. The problem is two sided—we may know the proportions in the universe, as we know the contents of a pack of cards, and ask what is the expectation of a hand with particular characteristics—the theory of bridge—or we may wish to infer the properties of an unknown universe from the examination of one or more samples. In sociological field investigation the latter is our problem.

It is well to attempt to distinguish biological problems from sociological. In the examination of species the universe may be considered as unlimited, and we are not concerned with the proportions which have different characteristics so much as with the variation of measurable attributes. In Mendelian studies, however, it is the proportions that are important, but we are still dealing with a hypothetical and unlimited universe. Life tables also relate to a hypothetical universe. Most of the investigations involving probability prior to the year 1900 or later were of this character. Quetelet was not concerned with sociological studies so much as with finding illustrations of the normal law of Error.

We are here concerned, on the other hand, with the investigation of the numerical structure of an actual and limited universe, or "population" which is the better word for our purpose. Our problems are quite

\* Read to the Study Group of the Royal Statistical Society, January, 1935.

definitely to infer the population from the sample. The problem is strictly analogous to that of estimating the proportions of the various colours of balls in a limited urn on the basis of one or more trial draws.

The first application of this principle to original investigation was, so far as I know, in 1912, when I was asked by a group of persons in Reading how best to use a small sum of money they had for the purpose of investigating the economic condition of the working-class in that town. I recommended the application of the pure method of sampling, in order to obtain valuable results in the time and with the money and other resources available. Then followed the investigations published in "Livelihood and Poverty," in "Has Poverty Diminished?" in parts of the "New Survey of London Life and Labour," in "Merseyside" and in "Work and Wealth in a Modern Port" where Professor Caradog Jones and Mr. Ford followed the same or a kindred plan. As is well known, the process of selection was to take a list of the houses in the area, usually in alphabetical order of streets, and to mark for investigation one in ' $n$ ' of the houses in this order. This is very literally the method of stratified sampling, and corresponded to Poisson's scheme of selecting balls from a number of urns in which the colours were in different proportions.

Another group of cases is found when the universe consists of a file of cards or sheets on which data relating to persons, households or other entities are already entered. In 1915 I obtained from the Census Office extracts relating to one family in fifty taken in order from the householders' schedules in a number of Boroughs. The resulting classification of the personnel of working-class families was published in *Economica* in 1921. In the following years Mr. (Professor) Hilton applied a similar method of selection in his studies of the circumstances of unemployed persons. From the bundles of insurance books at the Labour Exchanges one in each hundred was selected, and the details in it were amplified by direct interview with the claimant for benefit. I recommend a careful reading of Mr. Hilton's paper in the *Statistical Journal* of 1924 and of the discussion on it. There have been several other investigations of a similar character carried out and published by the Ministry of Labour. The Census authorities have not yet been persuaded to use the method in this country, with the result that we are still waiting for some of the most important tabulations of the 1931 Census. It is not, I think, generally known that the Japanese, when a great part of the tabulation of their Census was destroyed by the Tokio earthquake in 1923, took a sample of 1 in a 1,000—numbers 500, 1,500 . . . out of 11 million household schedules, and published the results for age and sex groups, size of households, etc., in 1924. The dis-

crepancies between the sample and the complete results subsequently obtained were unimportant and within the margins expected from theory.<sup>1</sup>

I may mention two other investigations by regulated sample in which I was concerned. On the outbreak of war a voluntary Committee was set up to examine the immediate affects on employment. I joined it on (I think) August 5th, 1914. We sent out forms to all firms in London included in the current Census of production, to one in twenty of the Home Office list of factories and workshops, and to City Offices. The principal questions were How many people were employed on July 21st, How many on August 21st? How many enlisted? How many part time? We issued the results on August 29th. This subsequently developed into a weekly or monthly return for the whole country, was taken over by the Board of Trade, and formed the basis for the study of recruitment, exemptions, etc., still if I remember right, in part on a sample basis. To complete this personal account—in 1917-8 returns were obtained by the Ministry of Food monthly from a systematic sample of the millers and bakers throughout the country as to the stocks and use of flour, so as to watch the effect of voluntary rationing, and determine whether there was a sufficient supply of cereals. The critical time was in the unrestricted submarine warfare of the summer of 1917, when the visible supply was for only a few weeks, and the home harvest some months distant.

A sample is of little use unless we know what universe it is a "fair" sample of, and have some means of judging its precision. The nature of the universe from this point of view differs greatly from case to case. In the Japanese instance the universe was the households from which Census returns were made. The unemployed investigation had an even better defined universe, namely that of insured persons making claims for benefit. In the towns' inquiries, the major definition was inhabited houses as enumerated in an accessible list, with the minor definition "occupied by persons designated as working-class under certain rules of classification." The important point is that the universe always implies the existence of a list of units or its equivalent. This list often does not correspond exactly to the universe that we really desire to investigate; for example we may be interested in unemployed persons independently of whether they are insured or not. It is further limited in many cases by the virtual inclusion of a clause such as "units about which information was obtainable." The importance of this is evident if we are dealing with budgets of expenditure. When the number of

<sup>1</sup> See *Bulletin de L'Institut International de Statistique*, Tome XXV Deuxieme Livraison, p. 121, Tokio Meeting, 1930.

defined units for which information is lacking is relatively small, we can consider the maximum effects of their exclusion, e.g., in the towns' inquiries we can compute the effect on the percentage classed as in poverty on the assumption either that all or that none of the excluded were below the poverty line, or assume that the proportion was the same in the unknown as in the known; or we can use supplementary knowledge to make a closer estimate. But on any of these plans we lose a great deal of the possibility of measuring the standard or other deviation of the estimate.

This possibility depends primarily on every one of the defined units having an equal chance of being included, which again depends on the existence of a defined and catalogued universe. Thus in *Economica* No. 1 there is a comparison by Miss Hogg of the number of persons dependent on women on the basis of the towns' inquiries, where the universe is defined, and of other inquiries made in sporadic fashion from imperfectly defined universes, in some cases with a strong bias to include women with dependents rather than without. When we have secured the essentials that the universe is defined and every member of it has an equal chance of inclusion, or that the chances differ in a known way from one section to another, as did the sampling factors in the New London Survey, then the working out of the standard deviation of the results depends entirely on mathematical formulae, which differ according to whether the selection was made purely at random or was stratified, or was representative etc., and to whether attributes or variables are in question. On these formulae I limit myself to one or two remarks. In my experience by far the most important factor is the universal  $1/\sqrt{n}$  where  $n$  is the number of units included in the sample. Of next importance is  $p$ , the proportion in the universe having the attribute in question, or  $s$ , the standard deviation when we are considering variates. If we take simply  $\sqrt{pq/n}$  or  $s/\sqrt{n}$ , we err usually on the safe side of overestimating the standard error of our estimate; for stratification reduces the error, as does the fact that the universe is finite, as does also the introduction of controls in a representative sample. In none of the investigations with which I have been concerned, nor in any of the artificial experiments I have made, have these factors been of importance, except in that they have guarded against underestimating the error. But, of course, there are cases where they increase the precision considerably, and then they should be estimated and given their due place in the formula.

How great should ' $n$ ' be? Since the labour of tabulation increases more rapidly than  $n$ , owing among other things to the greater difficulty of checking the work, and it is important to save expense and still

more important to save time, we ought to be prepared to answer this question. We can usually form some preliminary idea of the magnitude of  $p$  or  $s$  in the universe, and we can decide what precision we wish to attain. Thus if we expect  $p$  to be about .3, and we wish the standard error of the estimate to be as small as .01, so that the answer is of the nature  $30 \pm 1$  per cent, then the solution is given by  $.01 = \sqrt{pq \div n}$  so that  $n = 2,100$ .

In the New London Survey  $n$  was about 30,000, and the percentage of working-class families in poverty could have been stated as  $9.8 \pm .17$  so far as the error due to sampling was concerned. This was certainly as large a sample as was necessary, for it is useless to labour over the farthings when the pounds are uncertain. The different reasonable definitions, the ambiguity of Booth's definition, the lack of completeness in the returns and their doubtful accuracy in some cases, give occasion for a much wider limit of doubt than this .17.

I suggest that 1,000 is often a reasonable number to take for  $n$ , though of course, no rule can be laid down. This gives a standard error of  $p$  as .014 or  $30 \pm 1.4$  per cent when  $p = .3$ , which may be reduced by stratification.

In my experience the standard error of a *variable* is small. Thus in the Eastern Area in the New London Survey the size of working-class families made a frequency group whose average was 3.69 and standard deviation about 1.7. If the sample had been only 1,000 the standard error of the estimate would have been  $1.7 \div \sqrt{1,000} = .06$ , which is sufficiently small for many purposes.

The analysis of as small a pack as 1,000 is fairly rapid, and the expense and labour of collection is not very great; the number is also sufficiently large to ensure that all sections are included, and to neutralize chance errors in tabulation.

The importance of the rule of equal chances of inclusion needs emphasis, for it is easy to transgress it accidentally. Of course, if we only include the obvious or easy, we are limiting our universe, and I have always tried to avoid this by strict instructions that all the units selected in advance, and no others, should be reported on; when a house named proved to be uninhabited the next house on the left was to be taken. Since the mere fact that a unit numbered 1 may occupy that position owing to some attribute—it might for example be a corner house—the numbering of the list began a little after the beginning. The Japanese you may have noticed began at number 500. In Mr. Hilton's first inquiry an error was introduced by choosing the first comer to the Labour exchange in each packet of 100 books for interview, instead of deciding on the actual person beforehand. I have found

that the slightest departure from the rule may have serious results in introducing an unknown bias.

It is important to include questions that can be checked from other sources. Thus in a town sample the results should agree with those from the Census, the Education Authority's statistics, etc. If not, there is evidence of imperfection in the organization of a sample. In Reading, however, I found that I had to use the sample to correct the public information I received. The Education Authority gave me the average number of attendances, instead of the number on the school registers.

I do not propose to discuss the relation of the information afforded by the standard deviation to the inverse problem of inference to the universe, because that has recently been the subject of two meetings of the Statistical Society, the first of which is already published, and because it is too difficult to deal with briefly or non-mathematically. I will only say that as one handles an increasing sample one finds that the estimates converge within progressively narrowing limits, and as they become stabilized the natural man has more and more confidence in their adequacy, though his degree of confidence may not be proportional to any mathematical chance.

I pass on to cases where we cannot catalogue the universe, or have access to any unit we wish, or perhaps not even define the universe satisfactorily, as is the case in the realm of retail prices.

Here we have no theory of probability to help us to compute the standard error of the results, since the whole basis of the theory rests on known chances of inclusion or selection. Perhaps there is an exception in the formation of index numbers of prices, if we are justified in assuming that changes of price are uncorrelated with the definableness of the article or the accessibility of a record of prices. Sometimes we can assert with some plausibility that we are drawing at random from a great universe, and that the objects that we happen to find are not significantly different from those that elude us. Again, we may have good reason to think that absence of information is not correlated with the size of the quantity we wish to measure. For example—I have recently examined the cards of the New London Survey, with the intention of relating the number and ages of children in a family with the age of the mother and the occupational status of the father. In a considerable proportion of the cards the age of the mother is not stated and in many others it is obviously guessed as the apparent age; in fact, the investigators were instructed only to press the question of age for persons under 21 or over 60. So far as I can judge absence of information had more to do with the zeal or tact of the investigator than with anything connected with the number of children or the occupation of

the father. But here, as is often the case, the tabulation of the returns throw light on the adequacy and impartiality of the data. The ages congregated at particular numbers, not always round numbers, and this was the case in each grade of income I took. There appeared to be roughness and inaccuracy, but no bias. Apart from this the results showed the kind of regularity in increasing or diminishing numbers as one went up the age scale, and the diagrams representing the results showed the degrees of resemblance and difference that might be expected. Tabulation is usually a dull and tedious job, but there is a certain interest in watching the entries accumulating in a cross table and seeing the gradual growth of continuity out of randomness. When the results take the form of a regular frequency curve, and especially if we have reason to expect a normal curve and find it, we have good reason to suppose that we have measured satisfactorily a real entity. Thus the distribution of price changes or their logarithms on a normal scale gives a great deal of support to the validity of an index-number. In such cases the computation of a standard error is reasonable. But still in the absence of the pure conditions of sampling we are left in doubt as to what in fact is the definition of the quantity that we have successfully measured.

In general, sampling in an unregulated way is not necessarily useless but it can only yield tentative or suggestive results; their significance is a matter of judgment not of measurement, and there is a very great risk that the collection was biased, whether intentionally or not.

## CORPORATE EARNINGS ON SHARE AND BORROWED CAPITAL IN RATIOS OF GROSS INCOME (1918-1935)\*

BY LELAND REX ROBINSON

**T**HERE appeared in the JOURNAL for March, 1934, an article of the same title whose charts and table contained ratios of earnings for the entire post-war period through 1932, the year marking the low point in the depression which was well under way by the end of 1929. It is now possible to carry forward these figures through 1935, visualizing to this extent the course of revival during three years of better times, and comparing its tempo with that of the improvement which set in after 1921 when the first post-war depression scraped bottom.

For a technical discussion of the statistical methods used, their advantages and limitations, and other work in somewhat similar fields the reader is referred to the above-mentioned article by the same author. Here the briefest recapitulation must suffice.

From the standpoint of the investor, the business man, and the banker, the crucial question in connection with any undertaking is its capacity to convert the raw material of gross income into the finished product of net profit on capital employed. This capital includes both borrowed capital and share capital, and gross income comprises interest and dividends received on securities owned as well as revenues from ordinary operations. "Net profit" as used in Table I and the Charts, differs from "net income" in the ordinary sense of earnings on share capital. "Net profit" as here employed is built up by adding to "net income" (after deduction of taxes) all interest paid by the corporation on funded or unfunded debt.

It is evident that ratios of net profit to gross income (where net profit is taken as earnings, after taxes, on all capital employed, both borrowed and share, over the indicated period) are a more realistic gauge of business performance than are ratios of net income (taken as earnings on share capital only). With the former, changes in capital structure, such as alterations in proportions of borrowed and share capital, do not directly affect the ratios of earnings to gross income. With the latter these extraneous factors do have a direct and sometimes important effect upon such ratios from year to year. In other words, ratios of net profit to gross income would appear the better measure of busi-

\* Revision of a paper presented at the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 30, 1935.



TABLE I  
RATIOS (PER CENT) OF NET PROFIT TO GROSS INCOME<sup>1</sup>

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
Total (All corporations) <sup>2</sup> .....	6.5	6.5	4.0	0.1	5.1	5.3	4.5	5.3	5.3	4.6	5.3	5.6	2.5	-0.3	-2.8	1.3		
Representative corporations <sup>3</sup> .....	9.5	8.5	7.9	2.6	8.4	9.0	8.7	10.0	10.0	9.5	10.5	11.1	7.2	3.6	-0.7	4.3	5.7	7.1
Mining and petroleum (All).....	9.3	5.5	7.3	-4.0	4.1	2.8	2.0	7.5	8.8	4.3	7.1	9.1	2.8	-6.0	-7.5	-4.6		
Representative.....	19.5	12.3	12.2	1.8	9.5	8.6	9.1	12.8	12.8	7.3	13.0	15.6	7.2	-3.7	0.7	4.2	6.4	10.1
Total manufacturing (All).....	6.7	7.5	4.9	0.5	6.9	6.9	6.0	6.9	7.0	6.0	7.0	7.6	3.8	0.7	-2.7	2.3		
Representative.....	8.5	8.3	7.7	3.3	8.6	9.6	9.2	10.0	10.0	10.7	10.9	11.7	8.5	5.4	-2.5	5.1	6.1	7.7
Food products, beverages (All).....	4.2	3.6	2.3	1.1	4.4	4.7	4.5	4.0	4.6	4.2	4.6	4.8	4.2	3.2	2.5	3.9		
and tobacco.....	3.7	5.0	6.6	-1.5	8.6	10.3	10.3	8.6	8.3	8.5	9.2	8.5	8.5	8.4	9.2	10.1	10.6	7.7
Textiles and (All).....	6.4	9.6	3.1	2.5	7.1	6.7	2.7	4.5	2.3	4.3	3.2	2.6	-3.1	-4.0	-6.4	2.7		
their products (Representative).....	10.7	12.0	9.7	7.0	7.2	9.1	2.3	3.8	6.4	8.4	8.7	7.5	-1.1	-0.7	-9.0	6.0	1.4	1.7
Leather and its (All).....	5.4	8.4	-1.5	-2.5	5.0	3.0	3.3	3.5	3.2	4.6	3.4	2.7	-1.2	-2.6	-4.5	2.7		
Representative.....	7.9	7.3	3.3	5.0	9.1	7.7	8.7	8.6	7.7	9.7	8.7	8.4	7.3	7.1	5.6	7.4	6.6	6.3
Manufactures (Representative).....	7.4	8.8	0.3	-11.6	4.4	4.7	5.8	9.5	4.6	5.5	2.0	3.4	-1.5	0.0	-1.9	2.8		
Rubber products (All).....	9.2	9.9	5.2	-13.9	7.9	7.1	9.4	10.7	5.0	8.9	2.3	5.8	-0.2	1.4	-0.3	5.1	4.6	4.5
Representative.....	6.7	9.0	10.0	0.4	6.3	7.4	6.4	7.5	7.8	8.1	8.3	8.2	6.1	2.4	-2.4	4.0		
Paper, pulp and products (All).....	.....	.....	.....	4.7	11.4	15.3	10.5	11.0	9.9	9.0	10.5	11.4	7.3	3.3	-0.2	3.4	6.4	7.7
Representative.....	4.9	7.6	6.8	4.9	8.8	7.4	7.6	7.5	7.9	7.7	9.1	8.8	7.0	3.4	0.1	2.9		
Printing, publishing (All).....	-5.3	-3.2	2.2	9.6	6.9	7.8	6.4	7.8	9.3	15.5	16.3	16.5	14.6	10.1	-1.7	-1.4	3.0	5.4
and allied industries (Representative).....	6.5	7.8	5.5	1.3	9.3	7.7	8.6	10.2	11.3	7.2	11.5	8.8	6.0	3.7	2.8	3.8		
Chemicals and (All).....	7.0	8.8	9.8	6.4	15.4	12.5	12.1	12.4	14.3	15.6	17.9	19.2	15.7	13.5	15.5	15.4	15.6	19.5
allied products (Representative).....	8.4	9.6	8.9	4.6	9.9	12.4	10.5	10.6	10.3	8.3	8.9	8.4	3.9	-1.6	-11.6	-1.0		
Stone, clay and (All).....	.....	.....	29.7	11.3	11.8	14.4	20.2	22.4	18.8	16.8	19.0	17.2	16.1	4.2	-19.3	-3.3	8.2	8.2
glass products (Representative).....	8.8	9.9	7.6	-4.4	7.6	7.9	7.4	8.3	8.9	7.7	8.2	9.1	4.6	-1.6	-12.2	-0.9		
Metals and their products (All).....	9.0	8.6	8.6	6.3	8.5	9.7	9.0	10.4	11.3	11.2	12.1	12.8	9.5	4.5	-8.8	2.7	4.8	8.1
Representative.....	5.7	5.0	2.0	0.3	2.9	3.3	2.7	2.9	2.5	2.6	2.8	2.2	0.5	-1.1	-2.7	0.4		
Trade (All).....	6.1	6.5	3.2	1.0	6.8	7.0	6.7	6.9	6.6	7.0	6.7	5.6	3.9	3.5	1.7	3.1	4.6	4.4
Representative.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

<sup>1</sup> Percentage of gross income available for interest and dividends after deduction of all taxes.

Net profit is used in the sense of earnings, after all operating and other costs and taxes, on all capital employed, including capital borrowed on long and short term. In other words, "net profit" as here used is equivalent to "net income" in the commonly employed sense (i.e. earnings on share capital) after deduction of taxes, with all interest paid added back in again. As proportions of borrowed capital vary from company to company, from group to group, and even from year to year, the ratio to gross income of net profit in this sense have more significance as a measure of efficiency and earning power than ratios based upon net income which is arbitrarily affected by changes in the volume and proportion of borrowed funds used in the business.

<sup>2</sup> These figures are computed from *Statistics of Income*, Bureau of Internal Revenue. They include only those categories given in the table and corresponding to the categories of representative corporations.

These figures are based upon analyses of reports of leading corporations. See Table II.

TABLE II

AVERAGE NUMBER OF CORPORATIONS FOR WHICH INDIVIDUAL RETURNS WERE ANALYZED AND AVERAGE GROSS INCOME AS A PERCENTAGE OF THE GROSS INCOME OF ALL CORPORATIONS IN THE GROUP REPRESENTED

Industry Group	Average Number	Average ratios (per cent) gross income to gross for all corporations of group
Total	186	10.7
Mining and petroleum	41	42.9
Total manufacturing	118	11.9
Food products, beverages and tobacco	25	7.5
Textiles and their products	13	2.6
Leather and its manufactures	5	13.3
Rubber products	8	57.8
Paper, pulp and products	6	2.9
Printing, publishing and allied industries	5	3.4
Chemicals and allied products	10	2.2
Stone, clay and glass products	3	3.0
Metals and their products	43	24.1
Trade	27	5.3

ness efficiency, considered of course from a purely acquisitive viewpoint.

From another angle it seems wise not to omit such earnings as accrue to borrowed funds in computing the percentage of gross revenues coming through in the form of net. Only by taking earnings on all capital employed can the long-run capacity of enterprise to attract and wisely utilize savings be tested. To the extent that capitalization assumes the form of debt, net income on share capital alone must reflect the upward and downward leverage effects of prior lien fixed cost capital, thus distorting and magnifying any true picture of the ability of business to increase earnings during good times and its tendency to drop them during bad times.

Of course, earnings upon capital invested in the business are for this latter purpose a better indication than ratios of net to gross income. Capitalization, however, is sometimes as much a reflection of established or prospective earning power as it is of funds actually at work in the business. In view of the devices of modern accounting and the confusion of legal with economic principles in write-ups, write-downs, surplus items, par and stated values, there is a degree of arbitrariness in statements of capital and in changes therein which does not appear in most figures of gross income, despite limitations in the accuracy of the latter.<sup>1</sup> It is interesting to observe, however, that aggregate capital invested in corporations apparently not only gravitates toward their gross income but tends to vary with it, so that the percentage which net bears to gross is a rough indication not only of earning power on capital employed, but also of changes therein.<sup>2</sup>

<sup>1</sup> See this JOURNAL, vol. 29, (March 1934), p. 43.

<sup>2</sup> *Ibid.* page 43, and bottom Chart I, page 44. An interesting conformation of this fact is found in figures appearing in the "Special Survey" ("Analysis of Composite 1935 Balance Sheet and Income

The principal source of figures on American corporate income is of course the annual volume on *Statistics of Income*, published by the Federal Bureau of Internal Revenue. While these statistics are by far the most complete and accurate available, they are nevertheless two to three years late in publication, and throw little if any light upon current conditions. Therefore, in addition to using the Federal *Statistics of Income* it has been necessary to develop series of comparable corporate statistics based upon analyses of the returns of individual corporations.

The number of individual representative corporations whose published reports may be utilized for this purpose is limited by reason of the fact that the great majority of American corporations have not been in the habit of publishing figures of gross income. However, it has been possible to pick out a substantial number of leading and representative corporations which do give the necessary data in their current reports, and to group these corporations into the same categories as those which are presented in the Federal figures. In this way it is possible to compare the fluctuations in ratios of net profit to gross income in the two series. The results of this study are spread out in Table I. The average number of representative companies in each group, and the average percentage which their gross income bears to the gross income for all corporations in each corresponding category as set forth in the Federal *Statistics of Income* are shown in Table II.<sup>3</sup>

The data in Table I are presented in graphic form in the following charts. In all the charts there will be noted a substantial degree of conformity in the movements of the ratios of both series in the period from 1918 to 1933, the latest year for which complete Federal statistics

Account") of Standard Statistics Company, June 12, 1936. Here (page 2) it is noted that a total of 393 domestic corporations received an average return (fixed charges plus net income) of 6.5 per cent on their invested capital for 1935, as compared with 4.6 per cent in 1934. Of these 393 companies whose reports are in sufficient detail to permit "composite comparative analysis" only 219 gave such figures as "to justify an analysis of sales results." By the latter companies 6.2 per cent was earned on sales for 1935 and 4.4 per cent in 1934. The author's figures of the ratios of net profit to gross income for "representative corporations" (see Table I and Chart I in present article) give 7.1 per cent for 1935 and 5.7 per cent for 1934. The higher level of the latter figures, as well as the slower rate of increase from 1934 to 1935, may be accounted for (apart from lack of identity in the corporations analysed) by the fact that the Standard Statistics figures of earnings on sales are computed from net income (after interest paid), thus introducing the leverage factor which is based upon capital set-up and which does not appear in the present study.

<sup>3</sup> Obviously the term "representative" applies less to certain groups than to others. In "atoms, clay and glass" there are but two companies in the "representative" category and consequently the correspondence of their ratio movements to those of the inclusive government group is less satisfactory.

In utilizing the categories of corporations given in *Statistics of Income*, the author has discarded the following: "agriculture and related industries" (as corporate activity is not typical of agriculture); "finance" (because of wide diversity of non-comparable activities, such as banking, insurance, real estate, stock-broking, and holding company, included therein); "transportation and other public utilities"; "construction"; "forest products"; and "service-professional, amusements, hotels, etc." His figure for "all corporations"—both for representative companies and corporate activity as a whole, as reflected in *Statistics of Income*—is made up, therefore, of all the categories except those omitted as above mentioned.

have been issued. In certain of these groups the conformity is so close that the ratios of net profit to gross income for all corporations may be forecast with a reasonable degree of assurance by bringing up to date the ratios for individual representative corporations in the same categories.

Certain observations suggest themselves in an examination of the table and charts:

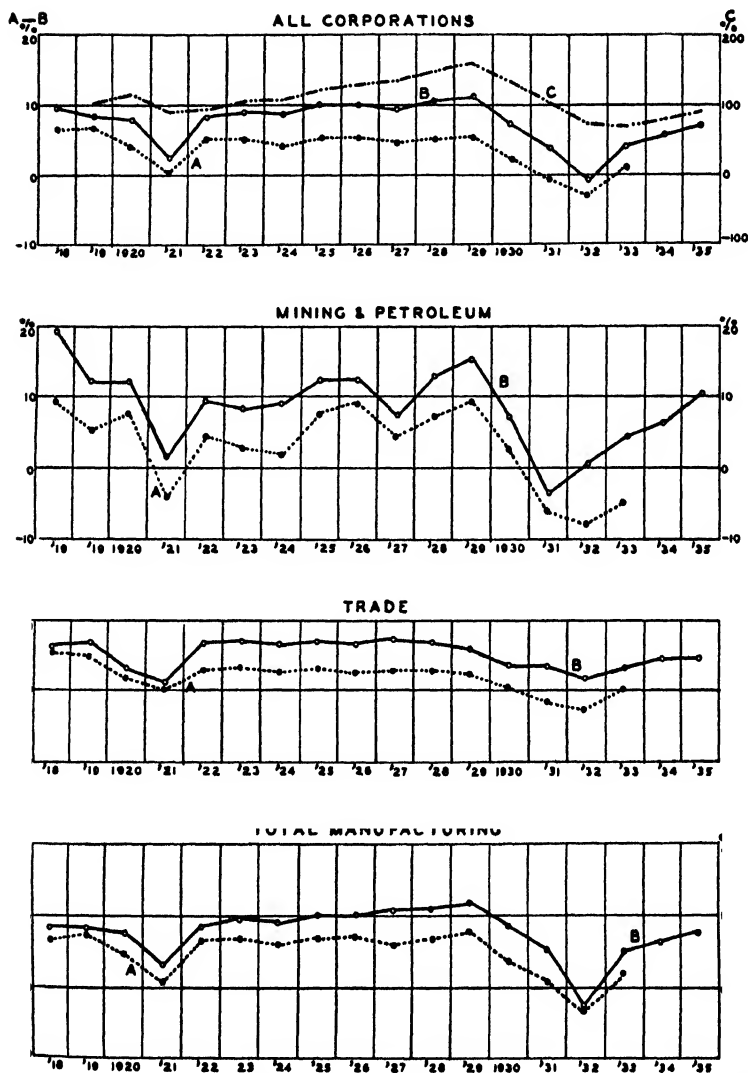
(1) Corporations as a whole show a surprising degree of regularity in the proportions of their gross income available as net earnings on total capital employed, including borrowed capital, in the years 1922–1929, during which period such ratio of gross available for net profit kept within  $4\frac{1}{2}$  to  $5\frac{1}{2}$  per cent, and averaged about 5 per cent. It is significant that in 1928 and 1929 this percentage was only a fraction of one per cent higher than in 1922, and was almost exactly the same as in 1923, 1925, and 1926, a slight drop being registered in 1924 and 1927.

The representative series for all corporations has shown the same broad variations from year to year, but these companies—being in general the larger and more successful units—register a higher percentage of gross available as net earnings, with a gradual upward trend discernible between 1922 and 1929, interrupted in 1924 and 1927. The ratio was slightly less than 9 in 1922, slightly less than 11 in 1928, and a little over 11 in 1929. While an increase in the percentage is shown from 1927 to 1929, it is by no means as great as might have been expected, in view of the mounting gross earnings in the latter years of the “New Era” prosperity.

Both series dropped sharply from 1929 to 1932 during which year, for the first time in the entire post-war period, the nation's corporations were earning less than nothing. Corporations in the representative series registered a marked upturn from 1932 to 1933 in their ability to convert gross into net, while the Federal statistics available only through 1933 show the same trend. The similarity of trend for the two series during the fifteen years since 1918 in which performance of the representative corporations may be compared with that of all corporations in the categories given makes it probable that when, two or more years hence, the Federal figures for 1935 are published, there will be shown from 3 to 4 per cent of gross transformed into net for corporations as a whole (see footnote 3) as compared with 7.1 per cent for representative corporations shown on Chart I.

(2) The dependence of corporate earning capacity upon volume of business is graphically depicted in the charts. Not only does gross income increase in years of prosperity, but there is also a tendency, often

CHART I  
RATIOS OF NET PROFIT TO GROSS INCOME



A: Ratio of net profit (amount available for interest and dividends after deducting all taxes) to gross income for all corporations in all categories represented—*Statistics of Income*.

B: Ratio of net profit to gross income for representative corporations in all categories represented—reports separately analysed.

C: Movement of bank debts for cities outside New York. (Monthly average for each year. Index: 1919=100.)

marked, for the percentage of this gross income coming through into net profit to rise. The opposite is true in the "years of the locust." The accentuated effect upon common stockholders of these wide swings in over-all earning capacity hardly requires comment these days.

This rough relationship between ratios of net profit to gross income and aggregate volume of business expressed in dollar amounts is visualized in the broadly similar movements of bank debits for cities outside New York (line (C) at the top of Chart I) and the earnings ratios for all corporations and for representative corporations. Variations of bank debits from a 1919 base are here taken as an approximate gauge of the trend of gross corporate receipts.<sup>4</sup>

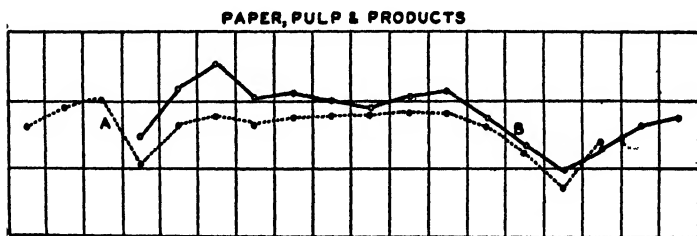
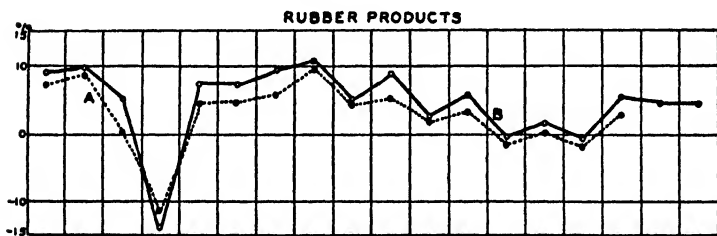
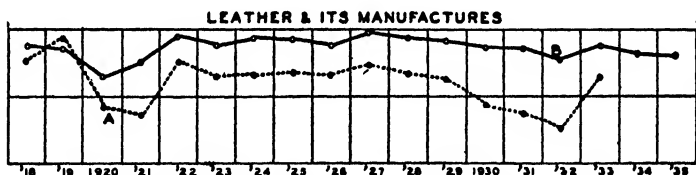
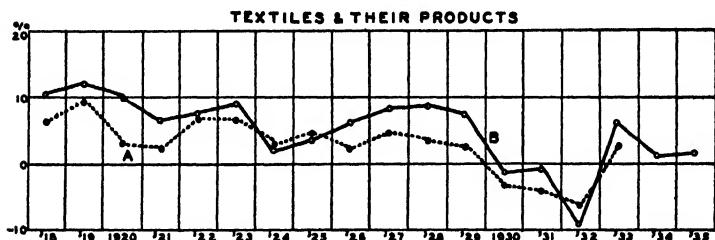
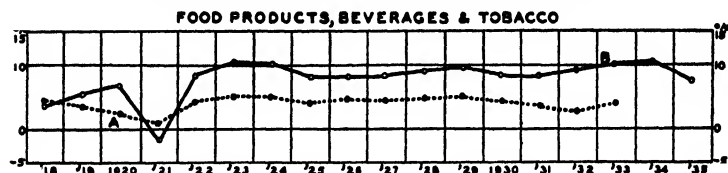
(3) Recovery from the depths of 1932 has been much less rapid—in so far as ratios of net to gross convey the story—than was the upturn following the nadir of the first post-war depression in 1921. During 1922 ratios of net to gross, for both the representative series and all corporations regained the approximate position which might be considered their long-term normal. On the other hand it would appear that not until 1936—four years after the "low" of the second post-war depression—will American corporations have recovered their reasonably-to-be-expected ability in converting gross income into net profit on capital employed.

(4) Ratios of net profit to gross income showed a high degree of regularity in Total Manufacturing, and here, as well, the two lines move practically simultaneously, the principal exception being in 1927. For all corporations the ratio was less than 1 per cent higher in 1929 than in 1922, the average for this period being about 7 per cent, with slight decreases in 1924 and 1927. Again it may be remarked that the increase in ratio from 1927 to 1929 is by no means as great as might have been expected in the boom preceding the present depression, and serves to point out the lesser degree of efficiency than is commonly supposed to have characterized industry in those years. The plunge from 1929 became even more precipitate from 1931 to 1932 (for representative corporations); and in the latter year the two series were close together in the No-Man's Land of algebraic negatives. The recovery in 1933 was sharp for both series, and for representative corporations in Total Manufacturing the present year will probably mark a restoration of normal post-war earning capacity in converting gross income into net profit.

(5) Among the different groups given in the table the greatest degree of stability from year to year is to be found in Trade, and in Food Products, Beverages and Tobacco, Chart II. In the latter the ratio for

<sup>4</sup> *Ibid.*, p. 47.

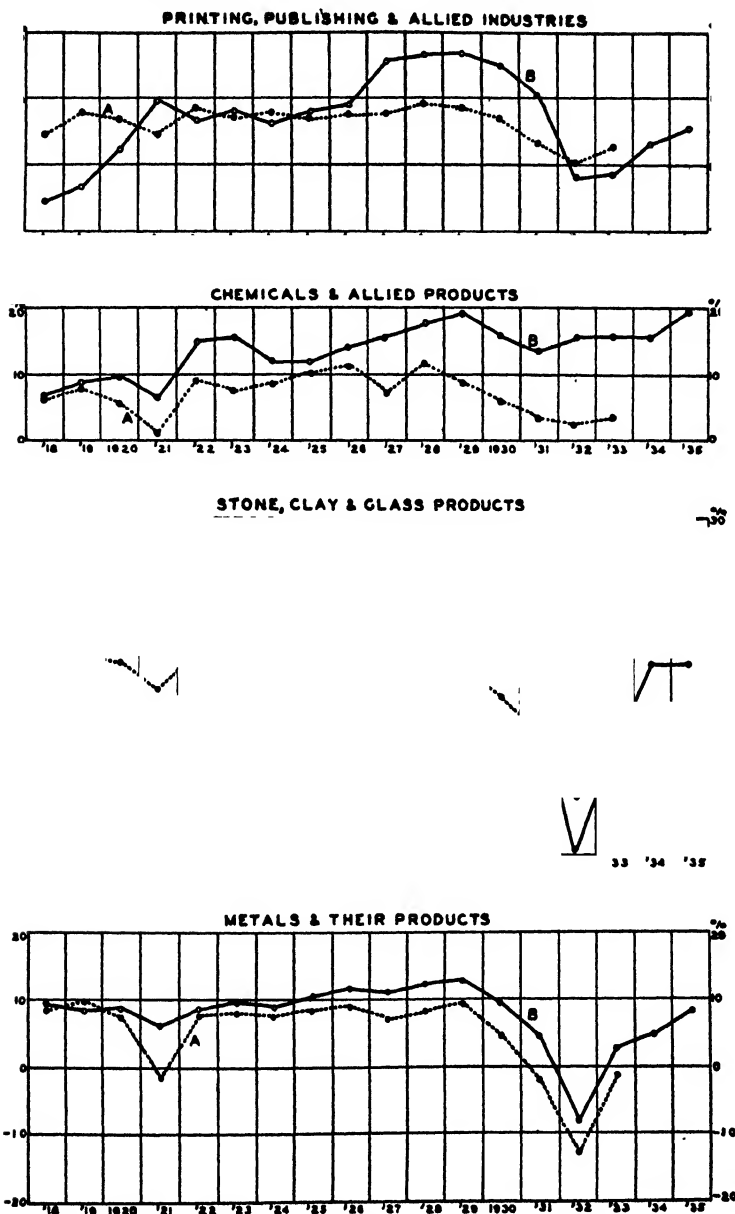
CHART II  
RATIOS OF NET PROFIT TO GROSS INCOME



A: Ratio of net profit (amount available for interest and dividends after deducting all taxes) to gross income for all corporations—*Statistics of Income*.

B: Ratio of net profit to gross income for representative corporations—reports separately analysed.

CHART III  
RATIOS OF NET PROFIT TO GROSS INCOME



A: Ratio of net profit (amount available for interest and dividends after deducting all taxes) to gross income for all corporations—*Statistics of Income*.  
B: Ratio of net profit to gross income for representative corporations—reports separately analysed



all companies is practically the same in 1929 as in 1922-1923, and it varies less than 1 per cent in the interim; while, for representative corporations in the same group, the ratio is almost exactly the same in 1931 as in 1922. In Trade there is a general downward trend, since 1922, in both the representative series and that for all corporations.

Corporations engaged in Trade suffered an elimination of their earning power in 1931 and 1932, but by 1933 had reached the black again. Representative companies in this group, however, showed earnings through the depression's depths and seem to have reached in 1934 and 1935 a stable ratio of earning power somewhat lower than obtained from 1922 to 1929.

Companies in the Food Products, Beverages and Tobacco group were comparatively little affected by the depression in ratios of net profit to gross income. The percentage carried through to net by representative corporations in this category reached, in 1934, the high points of 1923 and 1924, but declined in 1935. The charts show why shares in companies of this category are often called "resistance stocks" by investment bankers.

(6) One conclusion, among others, derived from these charts is that ratios of net profit to gross income suggest a long-term post-war downward trend in Textiles, and Rubber Products; a general upward trend in Chemicals and Allied Products; and a high degree of irregularity from year to year in Mining and Petroleum.

Apart from whatever light research of this kind may throw upon business movements in general, it is also of practical use in studying the performance of individual companies against the background of group experience. Any such application of this method, however, easily leads to unwarranted conclusions unless the characteristics and peculiarities of each company are taken into consideration, and the groupings are essentially homogeneous in character.

## THE PRACTICAL SIDE OF TRADE ASSOCIATION STATISTICS

By C. W. HALLIGAN

*The Rubber Manufacturers Association, Inc.*

THE COLLECTION and publication of statistics in most industries involves many problems of a practical and mechanical nature which must be reckoned with to insure the reliability, comparability and prompt distribution of facts for the guidance of the industry. It is the purpose of this article to present this phase of statistical work.

Trade association statistics may be divided into two general classes, first, the basic statistics for the industry which are readily obtained by individual companies from their existing accounting or statistical records, and, secondly, the more detailed statistics which are not regularly compiled by all members of an industry because of the clerical cost and effort required to compile them. In the first class may be grouped general sales statistics, statistics dealing with the raw materials utilized in the manufacture of the completed products and general labor statistics, such as the total number of employees and total payrolls. In the second class may be grouped the more detailed sales statistics by product classes and sizes, as well as production, shipments and inventory figures, capacity statistics and cost and special labor statistics.

There are very few industries which have any difficulty in securing fairly reliable information in the first group, for practically every company, regardless of size, must maintain some record of sales at least in dollars, and from their payroll records are able to ascertain, without any additional effort, the number of employees and also the total wages paid. This type of information is so fundamental that most companies in any industry desire such basic data to compare their trends and volume with the industry totals, and as a guide for the establishment of sales' policies. Some companies, however, do not feel justified in maintaining a clerical staff large enough to classify statistical data in the form desired by the majority in the industry, even though they may desire the final information if it could be secured without the expense of contributing information themselves. This attitude we find is one of the chief obstacles to the compilation of complete statistics which should be available as an aid to the stimulation of intelligent competition within any trade group.

In the rubber industry there are certain basic statistics that practically all manufacturers are interested in maintaining and to which they can contribute, without the use of any extra clerical effort. In this category can be classed our reports on crude rubber imports and crude rubber consumption and stocks. This information enables manufacturers to keep informed regarding the supply and demand for their principal raw material as a guide for establishing their purchasing policies. The reports are distributed to members much earlier than similar information on imports, for example, can be made available by the Department of Commerce. Our report on crude rubber consumption is the only source of information of this kind on a monthly basis. They are reconciled annually with total consumption figures published by the Department of Commerce. We also compile and distribute basic statistics dealing with the net sales value in dollars for all major rubber product groups. This information can also be furnished quite readily by practically any company without excess effort.

As examples of the more intimate type of statistics requiring extra clerical effort and which are not distributed to other than participants, we have a so-called Monthly and Cumulative Detailed Tire and Tube Report which shows the unit production and stocks of tires and tubes by sizes, together with unit shipments classified as between sales for original equipment on automobiles, replacement and export sales. This report is a very interesting compilation for any manufacturer as a guide in production scheduling and furnishes industry style and size trends, which would not be readily available to any individual company without an extremely costly market survey. This report requires a considerable amount of clerical effort for each participant, and it is therefore essential that its distribution be restricted to participants only, for if any manufacturer could secure such a compilation without contributing his own figures, he could secure all the benefits of the report without incurring the expense of becoming a contributor.

Another confidential report which it is necessary to restrict to participants only is one showing the per cent of capacity operated for one branch of the industry, which is issued on a weekly basis. This report is based upon the machine hours operated in relation to available machine hours and is designed to show the average per cent of capacity that this branch of the business is operating, which cannot be provided in any other way, inasmuch as the product is measured in yards of varying width, some single texture, others double texture, so that yards or value are not proper measurements of the activity of this group. Unless the distribution of such a report is restricted to participants, it would be extremely difficult to maintain a sufficient number of partic-

ipants to make the resulting figures worth the effort to compile them. The reports described are by no means a complete list of the statistical compilations made for the rubber industry, but merely serve as an example of the two general classes of statistics mentioned.

Most statistical compilations are of interest to the general public. Therefore, great pressure is frequently brought to bear on trade associations by economists, banks, brokers and promoters to secure reliable information of a detailed character. If this information were readily available to the general public, a majority of the smaller companies would not feel justified in incurring the expense of the necessary clerical effort for reporting their own information. For this reason, this type of information can be made more reliable and more complete by restricting its distribution to contributing members of the industry only, making it necessary for each company to submit a report before they can inspect the consolidated statement. This procedure sometimes appears rather high handed and arbitrary to non-contributors anxious to secure information which they know is available, but the writer believes that restricted distribution is justified in the interest of more complete statistics. After all most non-contributors are seeking this information for economic studies, or for personal promotion work of benefit solely to themselves.

Before statistics can be of any real value, their reliability must be established beyond any reasonable doubt. It is therefore of great importance that the central agency, to whom the reporting companies submit their most confidential information, establish faith in its integrity so that the individual reporting company will be assured that its data will not be revealed to anyone outside the confines of the central office. One of the steps that we take in the Rubber Manufacturers Association to accomplish this end is to return the original contributor's report with the completed figures, or in some cases, we keep the reports for a limited period of time for checking purposes and then destroy them so that we do not possess any individual company's figures which have been reported to us in the past. Our records consist solely of total industry figures. We believe that this faith in the central agency is the foundation of any reliable statistical compilation and insures the reporting of accurate facts.

In the collection of statistical information care must always be taken to define specifically what the contributor is expected to report. The mere request to report sales in dollars is utterly inadequate, for some companies may report gross sales, others net sales, according to their own interpretation of each term. It is essential that a very specific definition be given, itemizing any deductions that should be made

from gross sales if net sales are desired, for many companies within the same industry may have widely differing ideas as to the classification of expenses, some of which may be considered either as deductions from sales or as elements of cost, thereby destroying the comparability of the figures. As an illustration of such a definition of sales values, we quote below from our instructions to members when the sales value of domestically produced shipments is requested:

#### NET SALES VALUE OF SHIPMENTS

Represents net realized sales revenue from domestically produced rubber goods (including export) i. e., gross sales to customers less trade discounts, returns and all allowances, excise and sales taxes, transportation, provisions for adjustment losses, periodical volume rebates, price decline rebates, cash discount on sales, obsolete finished goods losses, allowances for factory shipments to customers and Royalties (Assessed on Sales Basis). Sales from company owned retail stores should be reported at wholesale value.

Another problem of vital importance in any industry in establishing the comparability of statistics from month to month is the varying number of participants. The industries which are able to maintain 100 per cent participation in their statistical reports over an extended period of time we believe are in the minority, as the management changes in the various companies from time to time, and with such changes come variations in company policy sometimes influenced by economic necessity, or through the personal idiosyncracies of the management. It is a constant ordeal for the statistical department in any trade association to continually solicit the non-contributors to participate, or renew participation after they have dropped out. In so many cases the potential contributor has not been fully informed of the existence of certain statistical compilations, or has not been made fully acquainted with the benefits that can be derived from such statistics. There does not appear to be any guaranteed panacea for maintaining regular participation—it simply requires unmitigated diligence on the part of those compiling the reports by following up delinquents and by educational measures to establish interest in the benefits of the service.

The tide of interest in statistics seems to rise and fall periodically, following generally, the business cycle. When business is good, the number of statistical compilations, considered desirable by an industry, seems to multiply until it becomes a voluminous mass of information requiring considerable clerical effort on the part of contributors, as well as in the central office. On the other hand, adverse business conditions call a halt to this expansion. When this happens, the pendulum usually swings in the opposite direction, according to our experience, making it necessary to exert every effort to maintain

and prove the value of the basic statistics for the industry in the general scrapping of apparently useless statistics during an economy wave.

Frequently, a delinquent participant renews participation in a report and submits figures for past periods which should be incorporated in the report to preserve its comparability and completeness. Since the report has been distributed without this single participant's figures, to send out corrected reports would mean that the identity of the additional participant and his figures would be disclosed which is not particularly desirable. In order to conceal the figures of such companies, but at the same time make our reports complete, we have followed the policy of never compiling amended reports for past periods, but merely incorporating the missing figures in cumulative statistical compilations, together with any corrections that have been brought to our attention since the original report was issued.

Unless statistics are issued with some degree of promptness, their value is lessened. It is therefore highly essential that steps be taken to insure the distribution of the report as soon as possible after the close of a period. The usual follow-up letters and telegrams, as reminders that reports are overdue, are not always successful in stirring delinquents to promptness. We have adopted a measure, that has met with some degree of success, of setting opposite the name of each participant the date its report was received in the Association office. Usually, our reports can be issued within a day after the receipt of the last participant's figures, so that these dates serve as a check on the efficiency of the Association Statistical Department and announce to the industry the delinquents who are responsible for the delay in issuing the report.

When an Association does not secure 100 per cent participation by all members of an industry, it is quite difficult to ascertain the degree of completeness of its reports in the industry. We have found it highly desirable to work closely with the Department of Commerce, giving every aid possible to insure accurate figures for the Biennial Census and any other special reports by which we can check the completeness of the Association figures. We have worked quite successfully along these lines for a number of years so that we are able to state on our reports the approximate percentage of completeness by which the figures can be raised to 100 per cent with some degree of accuracy.

It is our policy to make our statistical reports represent facts only, as reported by contributing members, unembellished in any way and without interpretation or predictions as to future trends. They are presented in a clear and precise manner, together with the percentage of completeness, where possible, so that each recipient can draw his own conclusions from the figures as presented.

## CHANGES IN THE WHOLESALE PRICE INDEX IN RELATION TO FACTORY EMPLOYMENT\*

By IRVING FISHER  
*Yale University*

THE CHAIN of causes most pertinent to the present study is:  
(1) money-shortage, or scarcity of dollars in circulation tends to make the dollar dear, that is, tends to reduce the price level,

(2) reduction in the price level tends to reduce employer's profits (or to turn profits into losses), by reducing their receipts without a corresponding reduction in their expenses, these expenses being largely fixed by contract—especially bond interest, rent, salaries and even wages, and

(3) reductions in employers' profits and increases in their losses lead them to reduce employment and to shut down production, that is to reduce the volume of trade.

These effects of price-declines on trade and on employment do not, however, occur at once but after a lag; and the lag is not a fixed lag but a lag distributed over a long period of time. I have previously<sup>1</sup> described this method in detail and will only summarize it here. In the investigations, price-decline occurring in any month, such as June, was taken as half of the two months' decline from May (or the month preceding the given month) to July (the month succeeding the given month), this two months' price decline (May to July) being reckoned as a percentage of the price-level of the said given month (June). Thus each month has its own separate percentage price-decline—or price-advance, as the case may be.

My working hypothesis is that the effect of each such price-decline begins immediately, in a slight degree, and then rapidly increases up to a maximum after which it very gradually decreases, tapering off almost indefinitely. The total distribution forms one type of a frequency distribution curve, or curve of probability. The type is a skew type but nearly "normal" if the effect  $Y$ , or ordinate, is plotted with the *logarithm* of time as the  $X$ , or abscissa, the time being reckoned from the month whose price-decline is under consideration. That is, the probability curve is nearly normal in the "geometric" sense, not the arithmetic.

\* Revision of a paper presented at the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 30, 1935.

<sup>1</sup> "Our Unstable Dollar and the So-called Business Cycle," *Journal of the American Statistical Association*, June 1925.

In still other words, it was provisionally assumed that, if the price-decline in a given month has its maximum or modal effect in, say, eight months, then its effect felt in a month half as far away (four months) would be the same as its effect in twice as far away (sixteen months) and, in general, that equal effects occur on the two sides of the mode at distances such that the distance to the mode is a mean proportional between them, i.e., that on a *logarithmic* time scale they are equally distant from the mode.

I then sought to find (using the logarithmic time scale) the "best" time-lag to the mode and the "best" standard deviation from that mode; that is, I sought to find the probability curve which, when used as the basis of calculation, would result in a series of calculated employment figures nearest to the actual employment figures.

The calculated employment curve is found by two steps. The first step is to apply the above probability curve separately to each month's price-decline, that is to calculate what its theoretical effects, following the duly distributed lag, would be. The second step is simply to combine, or add together, the many separate probability curves just specified, one curve for each month.

If we denote the index number<sup>2</sup> of prices at any month by  $P$ , and the percentage price-rise (or price-decline) in that number by  $P'$ , the total computed effect, in any month, of all the  $P'$ 's of previous months is denoted by  $\bar{P}'$ . Thus  $\bar{P}'$  may evidently be considered as an aggregate of the preceding  $P'$ 's.

A simpler way of stating this is that  $\bar{P}'$  is an hypothetical computation of what employment would be if its fluctuations were *wholly* due to the influence of previous price-rises or price-declines, the  $P'$ 's producing their effects after the duly distributed lag.<sup>3</sup> It remains to compare this  $\bar{P}'$ , or *computed* employment, with the *actual* employment<sup>4</sup> ( $E$ ).

It has been found that substantially the same results are obtained, and with far less labor, by using a short-cut. In this short-cut the lag instead of being distributed according to the above described skew probability curve, is assumed to be distributed according to a *straight line*, beginning at a maximum at one unit of time (month or quarter)

<sup>2</sup> The Wholesale Commodity Price Index of the Bureau of Labor Statistics was chosen for  $P$ , partly because its technique is best developed, and partly because changes of wholesale prices are most directly related to profits, which determine employment, or the employment (factory employment) of which we have statistics. It would be interesting to try other indexes such as Carl Snyder's General Price Index, or such as an index of "basic" commodities.

<sup>3</sup> For a fuller discussion of the method of establishing  $\bar{P}'$  see: "Our Unstable Dollar and the So-Called Business Cycle," *Journal of the American Statistical Association*, June 1925. See also Max Sasuly, *Trend Analysis of Statistics (Theory and Technique)*, Washington, D. C., The Brookings Institution, 1934, p. 201.

<sup>4</sup> The Federal Reserve Board Index of Factory Employment (Adjusted for Seasonal Variation) and revised according to the New Federal Reserve Board figures from 1927 to date, has been used for plotting  $E$ .  $E$  for October and November 1935 is Bureau of Labor Statistics figures linked to the September 1935 figure of the Federal Reserve Board seasonally adjusted index.



after the "cause" ( $P'$ ) and tapering off to zero after a specified number of months.

When this short-cut is used there is only one parameter of the effect, the total length of time to the vanishing point, instead of the two parameters in the longer method (namely the time from the given month to the mode and the deviation from that mode). By means of this short-cut, the labor of computation is greatly reduced.<sup>5</sup>

Some critics, unfamiliar with mathematical statistics, have argued that to adjust the parameter or parameters, so as to get the best fit, is making the fit to suit. This is answered in the 1925 article referred to. Suffice it here to say that, for such critics, a convincing answer is that, after finding the best fit for one period, if the very same formula, thus found best for that period, be then applied to any other period, it is found to give almost as good a result as if it had been based on the statistical data for this second period. In fact, to save labor I have, from time to time, brought the calculations down to date merely by using the law of lag found best for previous periods, although still better fits or correlations could have been obtained.

The results show that both trade<sup>6</sup> ( $T$ ) and employment ( $E$ ) have fluctuated as if they were under the influence of price-declines and price-advances, said influence being felt after a lag distributed according to a specified "law" of probability. The chart shows a general correspondence between  $\bar{P}'$  and  $E$ .

The comparison between the real and the computed  $E$  (that is  $\bar{P}'$ ) is thus simply the verification of the hypothesis that price-declines, after a lag, cause unemployment, that is, a reduction in  $E$ ; while price-advances after a lag, cause employment, that is, an increase in  $E$ . This verification is I think, sufficient to establish the general correctness of the hypothesis. But the correspondence between the actual and the computed fluctuation in employment is naturally far from exact; since many other causes operate concurrently.

Among other influences is the *direct* influence of money-shortage on  $T$  irrespective of the intermediation of  $P$ , technological improvements, seasonal influences, mobilization for war, demobilization after war.

I would call attention to the most outstanding cases of failure in the verification.

These seem to be chiefly three, namely:

- (1) The calendar year 1917 and the first half of 1918
- (2) From the middle of 1931 to the middle of 1932

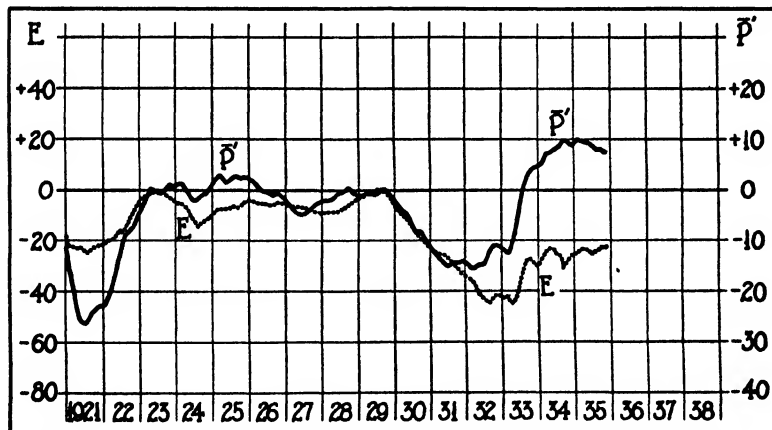
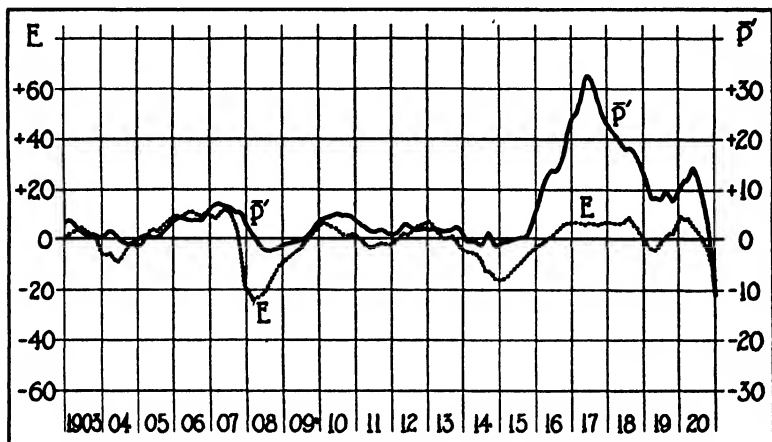
<sup>5</sup> For making the computation for this article and for several of my previous articles on this subject my thanks are due to Mr. Max Sasuly.

<sup>6</sup> For  $T$ , The Warren M. Persons' Index of Industrial Production and Trade, adjusted for seasonal variations and trend, has been used.

(3) From the middle of 1933 to date.

And all but the first of these three exceptions are also found when, in the comparison,  $E$  is replaced by  $T$ .

INDEX OF FACTORY EMPLOYMENT AND COMPUTED EFFECT OF PRICE  
CHANGES ON EMPLOYMENT, 1903-1935



EMPLOYMENT ( $E$ ) AND PRICE-CHANGE PROJECTED ( $P'$ )

Let us consider these three exceptions in order:

(1) The explanation of the fact that employment was flattened out in the United States in 1917 and part of 1918, while  $P'$  has a peak, is probably the military draft. The curve for the volume of Trade ( $T$ ) during this period and afterward, behaves somewhat differently,<sup>7</sup> but perhaps as we might expect under the influence of war.

<sup>7</sup> See *Booms and Depressions* or almost any of the other writings mentioned in previous footnotes

(2) The period between the middle of 1931 and the middle of 1932 (fall of  $T$  and  $E$  but rise of  $\bar{P}$ ) seems the most difficult to explain of the three. This exception is found not only in the United States, but throughout the world.<sup>8</sup>

(3) The third exceptional period is limited so far as I know to the United States, and begins about August, 1933. This was when the policy of restriction of production under the N.R.A. and A.A.A. began to have its effects. These included trade and production restrictions and therefore employment restriction. In particular, the N.R.A. hindered employment by reducing hours but not reducing pay per day and so artificially raising wage rates per hour. The dole and relief work likewise interfered with the ordinary processes by which employment would naturally be determined.

Finally, the restrictions on production changed the significance of the price-declines and price-advances themselves. Probably the period since 1933 is the only period in the charts when changes in the price-level as embodied in  $\bar{P}$  are not altogether the expressions of monetary causes. The result is that, for this period since 1933, there is no observable relation between the calculated  $\bar{P}$  and the actual employment  $E$ .

The interesting fact here is that the period dominated by N.R.A. and A.A.A. was an exception to the rule just stated. A rise of the price level due to monetary causes increases profits and, therefore, increases production, trade and employment, but a rise in the price level due to restriction on production, trade, and employment or consisting simply of arbitrary mark-ups of prices and wages, need not increase, and may decrease profits and therefore decrease production, trade and employment. This may explain why the rise of prices when due to the present Administration's restrictive policies, did not help employment as shown in our curves since July 1933 and also why, after the abolition of N.R.A., the arrest in the rise of prices due to the arrest of the scarcity policy did not apparently hurt but rather helped employment.

It may, perhaps, be said that all three of the exceptional periods mainly represented some sort of interference by Government (plus, of course, the drought and dust storms). At any rate, under ordinary conditions, both trade and employment vary with  $\bar{P}$  that is, price-declines (or price-advances) after the proper lags.

The chart, herewith given, is only for employment ( $E$ ) and extends only back to 1903. But in previous publications,<sup>9</sup> I have, as already

<sup>8</sup> For discussion, see "Are Booms and Depressions Transmitted Internationally by Monetary Standards?", XXII Session (London, 1934) de L'Institut International de Statistique, Section 2. Separate reprints.

<sup>9</sup> See "Our Unstable Dollar and the So-Called Business Cycle," *Journal of the American Statistical Association*, June 1925.

stated, shown similar results both as to trade  $T$  and  $E$ . These have been given by months (and compared with  $\bar{P}'$ ) back to 1903, and by quarters back from 1903 to 1877.

Similar but rougher calculations as to the volume of business and  $\bar{P}'$  have been made for 25 countries. As  $T$  and  $E$  usually run parallel, we are, I believe, safe in making the generalization, based on statistics for many years and for many countries, that employment varies with lagged price-change. This conclusion has been reached before. The present paper simply brings down to date, so far as possible, a series of my previous studies.<sup>10</sup>

Another investigator in this field is Henri Fuss. In an article, "Unemployment in 1925,"<sup>11</sup> after reviewing changes in employment and in the price level of many countries, he said: "... changes in the general price level have a very important influence on fluctuations in unemployment and employment." And the Report of the International Labour Office on "Unemployment and Monetary Fluctuations"<sup>12</sup> came to the following conclusions:

... it seems to be possible to declare emphatically that abrupt, or even slow but prolonged, variations in the general price level, or in other words, disturbances in the equilibrium between production and the means of payment, play no small part in determining the alternating acceleration and retardation of economic activity, and are hence an important cause of the recurrent unemployment crises which mark one phase of the cycle.

If, then, the magnitude of variations in the general price level could be reduced, an important cause of unemployment would be rendered less potent. . . .

*The League of Nations World Economic Surveys* during the past four years have contained valuable data on the subject of changes in prices, trade and employment. The last *Survey*,<sup>13</sup> in particular, calls attention

<sup>10</sup> "The Business Cycle Largely a 'Dance of the Dollar'," *Journal of the American Statistical Association*, December 1923, pp. 76-79.

"Fluctuation in Price Levels" in the *Problem of Business Forecasting*, Vol. 6 of the Pollak Publications, Pollak Foundation for Economic Research, Newton 58, Mass. Also Houghton-Mifflin and Co., June 1924.

"Our Unstable Dollar and the So-Called Business Cycle," *Journal of the American Statistical Association*, June 1925, pp. 179-202;

"Banking Policy and Unemployment," *American Labor Legislation Review*, March 1926, pp. 24-29;

"Statistical Relation between Unemployment and Price Changes," *International Labor Review*, June 1926;

"The Unstable Dollar as a Factor in the Credit Man's Problem," *Bulletin of the Robert Morris Associates*, July 1927;

*Booms and Depressions*, New York, Adelphi Company, 1932, xxi, 258 pp.

"The Relation of Employment to the Price Level," address given before the American Association for the Advancement of Science, Atlantic City, N. J. December 28, 1932 and later published in *Stabilization of Employment*, edited by Charles F. Roos, Principia Press, Inc., Bloomington, Ind., 1933, pp. 152-159;

"The Debt-Deflation Theory of Great Depressions," *XXI Session, (Mexico, 1933) de l'Institut International de Statistique*, Section 2. Also in *Econometrica*, October, 1933.

"Are Booms and Depressions Transmitted Internationally through Monetary Standards?" *XXII Session, (London, 1934) de l'Institut International de Statistique*, Section 2, Separate Reprints.

<sup>11</sup> Henri Fuss, "Unemployment in 1925," *International Labor Review*, 1926, pp. 228-230.

<sup>12</sup> "Unemployment and Monetary Fluctuations," report presented to the Twelfth Session of the International Labor Conference, May-June, 1929, in "Unemployment, Some International Aspects, 1920-28," *International Labor Office Studies and Reports*, Series, C.N. 13. Geneva, 1929.

<sup>13</sup> Series of League of Nations Publications, II. Economic and Financial, 1935. II. A. 14. pp. 60-67

to the disruption of the price structure by the decline of commodity prices and its adverse effect on productions and trade, which involves also employment. According to this *Survey* a rise of wholesale prices, while expenditures remain constant, tends to restore the equilibrium between different price groups (such as wholesale and retail; consumers' and producers'; farm products and manufactured goods) and is most helpful in promoting recovery. This recovery is most pronounced in the countries with depreciated currencies.

Mr. Fuss had another article on this subject in 1927,<sup>14</sup> and so did Mr. Norman Lombard in 1928.<sup>15</sup> Warren and Pearson, in their book, *Prices*,<sup>16</sup> 1933 and in the revision in 1935, under the sub-title *Gold and Prices*,<sup>17</sup> give charts and statistics showing the same general results as those reached by previous writers. One of their charts gives a comparison between the wholesale price index and unemployment in England in 1888-1934 and another gives a comparison between the wholesale price index and employment in Massachusetts in 1889-1934. Reference is also made to Canada, Sweden, Denmark and Germany. Another careful student in the field of employment is Major J. R. Bellerby.<sup>18</sup>

So far as I know, all students of the subject agree that price-decline is a major, if not the major, cause of unemployment. This is probably true without reservation when the price-decline is due to shortage of money.

There is, therefore, no great novelty in the conclusions of the present paper. In fact, for generations, it has been common knowledge, or at any rate a common observation, that falling prices cause trade depression and unemployment and that rising prices stimulate trade and employment. But before the method of distributed lag was brought forward in 1925, these observations related only to price movements which were either very long or very great, or both. The method of distributed lag shows that the same influences can be traced, almost month by month through short and milder price movements and even through short alternations of rise and fall. Finally, the statistical method (of distributed lag) is stressed as of value not only in the field here studied but in every other field where a lag between two time series is under consideration.

<sup>14</sup> *International Labour Review*, November, 1927.

<sup>15</sup> "Stabilisation of Employment and Central Bank Policies," *American Labor Legislation Review*, March 1928, pp. 87-89.

<sup>16</sup> *Prices*, 1933, and its revision, *Gold and Prices*, 1935, New York (Wiley) London (Chapman and Hall).

<sup>17</sup> *Ibid.*

<sup>18</sup> *Control of Credit as a Remedy for Unemployment*, P. S. King & Son, Ltd. 1923.

## DISCUSSION

Fisher's discussion of "Changes in the Wholesale Price Index in Relation to Factory Employment" deals with an economic theory which he regards as hypothetical, as something to be tested empirically, and of which he therefore proceeds to make empirical tests. Such an attitude toward economic theory and such testing, it will be generally agreed among statisticians, is the type of procedure economists should follow, if economics is to be scientific.

Fisher finds the verification which results from his tests "sufficient to establish the general correctness of the hypothesis" that "price-declines, after a lag, cause unemployment, that is, a reduction in  $E$ ; while price-advances, after a lag, cause employment, that is, an increase in  $E$ ." Yet many will feel that the evidence above presented for the relationship between prices and employment in this country is not adequate to this conclusion. While economic statisticians agree that economic hypotheses such as Fisher's should be tested statistically, they are not in entire agreement as to what constitutes a satisfactory statistical test.

There are offered here for consideration some proposed standards for statistical validation of hypotheses which have not been met in Fisher's paper.

1. Specifications regarding data, methods, and concepts should be adequate. Adequacy will here be defined only negatively and by enumeration.

The type of changes in prices and employment under consideration is not clearly stated. It is presumably "cyclical" in that Fisher's  $E$  curve is corrected for seasonal variation and apparently for trend at least from 1903 to 1920.

We are not told what the factory employment curve represents prior to 1919, and more especially prior to 1913. The method of seasonal adjustment prior to 1919 is not specified. The method of trend correction is not specified. No reference to a previously published statement of these points is made.

With respect to the derived wholesale price curve, Fisher does not specify either here or in his earlier article on the method of distributed lags<sup>1</sup> precisely how many successive monthly increments of the wholesale price index are used to compute a monthly ordinate of his  $\bar{P}$  curve, or how this ordinate is computed from them.

2. In addition to a clear specification of what data are used there is need for comment on the significance of their known characteristics for the problem in hand, and need for careful limitation of the conclusions in the light of these characteristics. Fisher offers no discussion of the comparability of the two indexes for his purposes. The conclusions are not always clearly limited to factory employment. No mention is made of the varying reliability of the indexes in different periods.

3. To establish a causal relation between one type of cyclical variation,

<sup>1</sup>*Journal of the American Statistical Association*, June, 1925.

$P$ , and another type,  $E$ , it should be shown that  $P$  precedes  $E$  in a sense in which  $E$  does not precede  $P$ . Fisher does not do this. His evidence for a lag involves two steps: (1) His derived price curve  $\bar{P}'$  is made up by lagging a function of several successive monthly increments in the wholesale price index after these monthly increments. This gives his distributed lag effect for the derived price curve  $\bar{P}'$  behind the curve of price increments  $P'$ . (2) The derived price curve is then examined visually for agreement on a synchronous basis with the factory employment curve. Thus,  $E$  is shown to lag behind the curve of monthly increments in the price index, not to lag behind the price index curve itself. It may conceivably be true at the same time that  $P$  lags analogously behind the curve of monthly increments in factory employment. When two time series,  $A$  and  $B$ , can be represented by synchronous sine curves, the curve of monthly increments in each will lead the other curve. But one would not be justified in noting that the curve of monthly increments in  $A$  leads the  $B$  curve and then concluding, as Fisher does, that changes in  $A$  cause changes in  $B$ .

With respect to Fisher's lag technique, we may note first that the operations involved in computing the derived price curve have the effect of producing a curve which bears a somewhat definite relation to the original price index curve.  $\bar{P}'$  differs from  $P$  in that both major trend features and sporadic month-to-month variations are missing. Yet the remaining movements are recognizably similar and appear to synchronize in  $P$  and  $\bar{P}'$ , although the relative amplitudes of these (chiefly cyclical) fluctuations in  $P$  and the dates of the maxima and minima are not always maintained in the derived price curve. Fisher offers no evidence that  $\bar{P}'$  lags behind  $P$ , and hence no evidence either that  $E$  (which appears synchronous with  $\bar{P}'$ ) lags behind  $P$ , or that changes in factory employment lag behind changes in the wholesale price level.

We may note second that while the derived price curve, except for minor sporadic variations and major trend features, bears a readily recognizable resemblance to the original price index curve some of the relative amplitudes of the cyclical fluctuations in the two curves differ markedly. Thus in  $\bar{P}'$  the 1917 level is above that of 1919; the magnitude of the 1920-1 drop is about twice that of the 1929-31 drop; the post-1929 drop ends in mid-1931 instead of early 1933; and the level of 1934-5 is above the 1929 level. It will be recalled that Fisher finds difficulties in comparing  $\bar{P}'$  with  $E$  in 1917-8, 1931-2, and 1933-5.

4. The argument from *post hoc* to *propter hoc* is precarious at best; it calls for special care when applied to cyclical variations. Many series move up and down with the ups and downs of business. Assuming that Fisher had established that cyclical movements in the wholesale price index precede those in the factory employment index (although a synchronous relationship is more nearly consonant with his evidence), would this show anything except that prices respond more quickly than employment to a common influence?

Fisher's hypothesis involves an intermediate causal link on which few monthly data are available; the sequence is (a) price change, (b) profit change, (c) employment change (and change in physical volume of business). If a (selling) price increase is to increase profits and so increase employment, the price increase and the employment increase should be evident in the same industry. Because the wholesale price index and the factory employment index differ considerably in weights and selection of items, the positive correlation between commodity price movements and changes in factory employment should, according to Fisher's hypothesis and barring the type of exceptional case he considers in 1917-8 etc., be improved if we examine this relationship industry by industry. But if it should appear that some industries account largely for the cyclical fluctuations of the price series and other industries account largely for the fluctuations of factory employment, such a finding might suggest that when industries are responding to a common pressure of improving or declining prosperity, some respond more readily in price changes, others more readily in physical volume changes.<sup>2</sup>

To recapitulate, it is suggested (1) that fuller specifications of data, methods, and concepts should have been provided; (2) that greater care should have been exercised to delimit the conclusion in the light of what is known about the factual evidence employed; (3) that while a lag is established, no statistical analysis is offered that shows this lag more nearly consistent with a causal influence of  $P$  on  $E$  than with a causal influence in the converse direction; (4) that the validity of the argument from *post hoc* to *propter hoc* might in this case have been either partly confirmed or else definitely disproved by examining the relationship between  $P$  and  $E$  industry by industry.

MORRIS A. COPELAND

Central Statistical Board

# REJOINDER

Professor Copeland infers that I must have intended to restrict the correspondence between  $P'$  and  $E$  to cyclical movements, because the seasonal and trend movements had (for  $E$ ) been eliminated.

It is true that when I had a choice of indices for  $E$ , I chose the series from which seasonality and trend had been eliminated. But I made no special point of such elimination nor, in any case, did I myself calculate them. Through all my various studies on lagged-price-change in relation to employment, trade, and other variables I have used whatever figures I found available, ready made for me by others. In many cases there had been no such eliminations.

Moreover it would be very rash to assume that after such eliminations the resultant series is cyclical or even near-cyclical. As is well recognized,

<sup>2</sup> Cf. Gardiner C. Means, this JOURNAL, vol. 30, June, 1935, esp. p. 405.



these residual movements at least contain non-cyclical ingredients. Furthermore the cyclical ingredients are, or may be, so numerous and conflicting<sup>1</sup> that their resultant is probably never definitely cyclical in any period of time so short as included in this study. For these reasons I would distrust any seeming cyclical movements.

Professor Copeland suspects that such cycles exist, with corresponding cycles in  $P$ . But he gives no evidence of this nor of any rationale for some common cause.

I agree, of course, that it would be interesting to reverse the lag calculations and to see whether  $P$ , or  $P'$ , or  $\bar{P}'$  may not be found to follow  $E$  as well as to precede  $E$ . I hope Professor Copeland will make such a study, if he thinks it worth while. Meanwhile we may at least say that the results so far conform to my working hypothesis, and that this hypothesis is a rational one. Even most of the few exceptions found have plausible explanations. The only important exception which still puzzles me is for the year 1931-2.

Moreover, even if it should some day be found that reverse causal relationships exist, this would not, as Professor Copeland seems to think, disprove the existence of the direct causal relationships of which I have shown evidence. On the contrary, in any study of booms and depressions we must always deal with vicious circles. We may joke over whether the egg precedes the chicken or the chicken the egg, but we know that both are true and that both are true causally.

It would be still more interesting, as Professor Copeland suggests, to study the price-employment problem with relation to different industries. I much hope this may be done.

As to the "fuller specifications of data, methods and concepts," I am sorry if any essential specifications have been omitted; for it has always been my practice to make it possible, through specifications or references given, for any readers who so desire to repeat the work. In previous articles specifications are given at greater length and where specifications are brief or omitted, references are given to sources. It would have been a great waste of space to describe how other authors derived their data,—for instance, how Dr. Persons eliminated from  $E$  the trend and seasonality.

It should be remembered that, in all these studies, the only contribution of my own has been the calculation of  $\bar{P}'$  from  $P$ . The methods used were described fully in my previous articles cited, especially "Our Unstable Dollar and the So-called Business Cycle."

IRVING FISHER

<sup>1</sup> See my "Business Cycles as Facts and Tendencies," *Overdruk uit Economische Opstellen, Aanboden aan Prof. Dr. C. A. Verrijn Stuart, Haarlem, de Erven F. Bohn N.V.*, 1931.

## FACTORIAL AND CORRELATIONAL ANALYSIS OF THE 1934 VOTE IN CHICAGO

BY HAROLD F. GOSNELL AND MARGARET J. SCHMIDT  
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IN THE present study a comparison is made between the multiple factor methods and partial correlation techniques in analyzing data regarding voting behavior in the city of Chicago. The city was divided into 147 units into which election and census material could be conveniently fitted. For experimental purposes, it was decided to include seventeen variables, four of which were taken from successive election returns. The election variables were calculated by finding the percentage of the total vote received in each area by the Democratic candidate. Since the votes received by minor party candidates were so small, they were neglected. Consequently, the Republican percentage could be calculated in any given area by subtracting the Democratic percentage from 100. The other variables were selected carefully on the ground that they had some specific contribution to make to the understanding of the political variables. Lack of space does not permit the full consideration of the reasons for selecting each of the variables and of the limitations of each for the purposes in hand.<sup>1</sup> All of the variables are expressed in percentage form except median rental and Table I gives certain characteristics of their distributions.

The votes selected for Table I are satisfactory for some purposes but they do not reveal clearly the steady trend toward the Democratic Party since 1927. The peak of Democratic popularity appears to have been reached in the election of a United States senator in 1930. However, the vote which James Hamilton Lewis received as the Democratic candidate for this office does not represent the true strength of his party at this election. He ran far ahead of his ticket because his opponent, Mrs. Ruth Hanna McCormick, the first woman to receive a major party nomination for the office, had incurred the enmity of a prominent faction of the Republican party and had received unfavorable publicity in connection with the Senate investigation of campaign funds. Mrs. McCormick's slight of well-known Republican leaders, her expenditure of half a million dollars to win the nomination, and the fact that she was a woman, made her a weak candidate. In order to

<sup>1</sup> Some of the variables are discussed in H. F. Gosnell and N. N. Gill, "Analysis of the 1932 Presidential Vote in Chicago," *American Political Science Review*, XXIX (December, 1935), pp. 967-984 and in H. F. Gosnell and M. J. Schmidt, "Relation of the Press to Voting in Chicago," *Journalism Quarterly*, XIII (June, 1936), pp. 129-47.

TABLE I  
VARIABLES USED IN STUDY OF 1934 CONGRESSIONAL VOTE IN CHICAGO  
(N=147)

Variable	Letter Symbol	Date	Per cent for City*	Mean	Lowest Item	Highest Item	Standard Deviation
Smith Vote	a	1928	49.2	51.7	23.5	88.1	15.0
Lewis Vote	b	1930	72.1	76.0	42.9	91.5	8.6
Roosevelt Vote	c	1932	59.2	63.4	29.6	90.0	13.1
Igoe Vote	n	1934	64.0	66.4	34.4	92.2	12.5
Women Voters	d	1930	41.8	40.4	8.5	52.5	6.8
Party Vote	e	1932	58.4	58.4	28.1	87.3	12.0
Bond Issue	f	1930	58.0	56.6	43.8	85.6	7.7
Wet Vote	g	1930	78.6	78.4	59.7	93.3	5.7
Voting Interest	h	1930	66.3	66.8	34.2	104.1	11.0
Foreign Birth	i	1930	26.9	31.2	13.2	67.3	10.9
Catholic Origins	j	1930	32.4	34.1	4.2	84.6	21.0
Median Rental	k	1930	\$49.56	\$47.50	\$15.22	\$129.40	\$18.50
Home Ownership	l	1930	31.1	35.8	.7	82.5	19.1
Unemployment	m	1931	22.7	28.3	3.7	69.4	12.5
Mobility	s	1934	27.6	25.0	11.5	49.0	6.9
Doubling-up	t	1934	8.0	6.9	1.8	14.5	2.2
Education	u	1934	26.1	24.8	5.5	66.7	15.6

\* All figures are expressed in terms of percentages except median rental which is given in dollars. For variables a, b, c, and n, the totals used to calculate the percentages were the sums of the Democratic and Republican votes in each of the 147 areas. The other variables were calculated in the following fashion. Variable d is the percentage who were women of the total number of registered voters in October, 1930. Variable e is the percentage that the straight party votes were of the total votes cast in November, 1932. Variable f is the percentage "yes" votes cast for a 1930 bond issue. Variable g is the percentage "yes" votes cast on the 1930 public policy referendum calling for the repeal of the Eighteenth Amendment. Variable h is the percentage of the adult citizens that registered in October, 1930. Variable i is the percentage of adult citizens who were born in foreign countries. Variable j is the percentage of the total population born, or whose parents were born in the following countries which are regarded as Catholic countries: Irish Free State, Poland, Czechoslovakia, Austria, Hungary, Yugoslavia, Lithuania, Italy and French speaking parts of Canada. Variable k is the percentage of the total families that own their homes. Variable l is the percentage unemployed in 1921 of the gainful workers ten years of age and over. Variable m is the percentage of the total families that had lived less than one year at present address. Variable t is the percentage of total families with one or more subheads. Variable u is the percentage of the population, 18 years of age and over, which had completed more than ten grades in school.

Election returns were obtained from the *Chicago Daily News Almanac and Year Book*, the *Public Service Leader* and the records of the Board of Election Commissioners of Chicago. Census data were taken from E. W. Burgess and C. Newcomb (Eds.), *Census Data of the City of Chicago, 1930* (Chicago, 1933) and C. A. Newcomb and R. O. Lang, *Census Data of Chicago, 1934*, (Chicago, 1934).

The sections in which the population was 20 per cent or more Negro were excluded because these districts were atypical and destroyed the tendency which most of the distributions showed toward normality. Since the methods employed in this study assume normal distributions, it was regarded as desirable to consider the white voters only. One of the authors has written at length regarding the voting behavior of Negroes in Chicago. See H. F. Gosnell, *Negro Politicians: The Rise of Negro Politics in Chicago* (Chicago, 1935), pp. 15-92.

get comparable figures for the 1934 vote for congressman-at-large, the election returns for the same office are substituted for the Smith, Lewis, and Roosevelt votes in Table II.

James Hamilton Lewis, Democratic candidate for the United States Senator in 1930, ran much better than his fellow candidates, as comparison of his vote with that received by the Democratic candidates for congressman-at-large indicates. A comparison of Table II with Table I also shows that the percentage for Igoe is almost the same as the average percentage Democratic. Since the Igoe vote was much easier to calculate,<sup>2</sup> it was used as a measure of the Democratic strength in each of the 147 units employed.

<sup>2</sup> The percentage that Michael L. Igoe, Democratic candidate for congressman at large, received of the sum of his vote and the vote for C. Wayland Brooks, leading Republican candidate for the same

TABLE II  
CONGRESSIONAL ELECTIONS IN CHICAGO, 1928-1934

Year	Total Average Vote Cast for Congress- man-at-large*	Total Average Vote For Democratic Candidates	Per Cent Democratic
1928	1,173,425	532,036	45.4
1930	827,751	490,954	59.3
1932	1,269,698	725,456	57.1
1934	1,099,974	712,612	64.8

\* Two congressmen are elected at large from Illinois. The city of Chicago has about one half of the voters in Illinois. The average was found by adding the votes for all Democratic and Republican candidates and dividing by two.

It is difficult to handle as many as seventeen variables by the ordinary statistical techniques. Some statisticians say that for partial regression equations not more than four or five variables should be used. From the logical standpoint it is clear that it is foolish to express the Smith vote as a function of the Igoe vote, on account of the time element. Consequently, the Igoe vote furnishes the only proper starting point. Can the Igoe vote be explained in terms of the Roosevelt vote? Columns *c* and *n* of Table III show the relationships of these two variables to the fifteen remaining variables in the 147 units. Product moment coefficients of correlation for the ungrouped data were calculated in each case.<sup>3</sup>

While the Igoe vote was on the average 3 per cent higher than the Roosevelt vote in the various sections of the city, the coefficients show that there was a close relationship between votes for the two candidates. In fact, the Igoe vote was most highly associated with the Roosevelt vote as the coefficient of  $.960 \pm .01$  indicates. Considering the fact that in some of the areas many people had moved in the two-year period following the 1932 election, this coefficient is remarkably high. In other words, party tradition and party organization appeared to account for most of the variations in the Igoe vote. Where Roosevelt had been strong, Igoe was also strong and vice versa. However, there were some minor shifts in the Democratic support. Most of these can be accounted for on the theory that in 1932 the Republican support

<sup>3</sup> With  $n=147$ , P.E. for the values of  $r$  in Table III ranges from .083 when  $r=.01$  to .008 when  $r=.96$ . When  $r$  is .56 it is ten times its P.E. When  $r=.36$  it is five times its P.E. The  $t$  values for the significance of an observed correlation [R. A. Fisher, *Statistical Methods for Research Workers*, (London, 1932), pp. 171 ff.] range from .963 when  $r=.01$  to 41.285 when  $r=.960$ . Some of the intermediate values are given below:

$r$	$t$	$r$	$t$
.204	2.509	.565	8.245
.272	3.403	.636	9.924
.361	4.661	.785	15.250
.464	6.307		

It is apparent that with such large values for  $t$  beginning with a coefficient as low as .204 that sampling problems are not serious in this study. It should further be kept in mind that from the historical point of view, we have made a complete study of a limited universe. Sampling becomes important when one draws inferences from the Chicago data that might apply to other American metropolitan communities.

came largely from the Protestant, employed, well-educated, native born, relatively prosperous groups that tended to be drier than other groups and which had a larger proportion of women registered as voters. The Democratic gains of 1934 were made among people who had been formerly Republican. Consequently, the relation between the Igoe vote and political, social, and economic variables should logically be slightly less close than the relationship between the Roosevelt vote and these variables. This was the case for every variable except the following: party voting, women, bond issue, and mobility. The differences between the coefficients in columns *c* (Roosevelt vote) and column *n* (Igoe vote) involving variables *d*, *e*, *f* and *s* are zero or very small, but if an explanation is wanted, it would emphasize the fact that all of these variables were closely related to the measure of party voting. Since the Democrats had more patronage in 1934 than in 1932, we might expect the Igoe vote to be more highly correlated with organizational influences than the Roosevelt vote. A relatively large difference was found between the coefficients involving the wet vote and the Igoe and Roosevelt votes. This may be due to the fact that the repeal of prohibition had become a dead issue. As in the case of the Roosevelt vote, the Igoe vote has no apparent relationship to the variables doubling up and home ownership.

The fact that the variations of the Igoe vote as between the different areas so nearly paralleled the variations of many other measures raises a number of questions. If some of the variables are closely related to each other, does not this mean that they are measuring the same thing? In order to get as full a picture as possible with the data at hand, it is necessary to find the intercorrelations of all of the variables. This involves the calculation of 136 coefficients, each of which is presented twice in Table III, a symmetrical table called a *correlation matrix*. The repetition of the coefficients is necessary in order to facilitate the calculation of the multiple factor loadings to be described later.

A detailed comparison could be made between the intercorrelations of the Igoe vote and those of each of the other variables. However, such a procedure would leave a confused impression. The correlation matrix may be presented in a much simpler form by going through certain transformations devised by Professor L. L. Thurstone under the name of *multiple factor analysis*.<sup>4</sup> It is not feasible within the limits of this paper to discuss the theory and mathematics of this method. One purpose of multiple factor analysis is to determine how many general and independent factors it is necessary to postulate in order

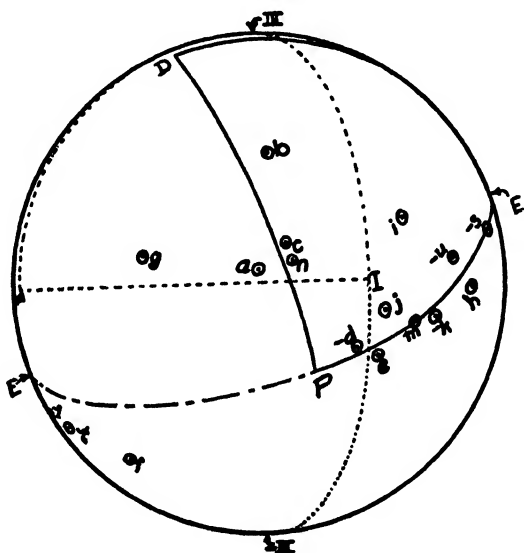
<sup>4</sup> For a description of the methods of multiple factor analysis see *The Vectors of Mind, Multiple-Factor Analysis for the Isolation of Primary Traits* (University of Chicago Press, 1935).

TABLE III  
CORRELATION MATRIX  
INTERCORRELATIONS OF SEVENTEEN VARIABLES RELATED TO VOTING BEHAVIOR IN CHICAGO, 1930-1934

	Let- ter Sym- bol	Smith a	Lewis b	Roose- velt c	Igce n	Wom- en d	Party Vol- ing e	Bond Issue f	Wet Vote g	Voting Inter- est h	For- eign Birth i	Cath- olic Ori- gins j	Med- ian Rental k	Home Owners l	Unem- ploy- ment m	Mobil- ity n	Doub- ling Up o	Educa- tion u
Smith	a																	
Lewis	b	.78																
Roosevelt	c	.94	.84															
Igce	n	.91	.81	.96														
Women	d	-.57	-.55	-.66	-.66													
Party Voting	e	.70	.62	.84	.85	-.68												
Bond Issue	f	.47	.17	.40	.44	-.37	.45											
Wet Vote	g	.64	.62	.62	.57	-.34	.42	.50										
Voting Interest	h	.35	.21	.27	.27	-.21	.48	.10	.10									
Foreign Birth	i	.64	.60	.73	.71	-.51	.66	.14	.38	.32								
Catholic Origins	j	.78	.78	.78	.76	-.54	.75	.20	.34	.32	.72							
Median Rental	k	-.62	-.53	-.68	-.64	.58	-.76	-.12	-.34	-.43	-.66	-.74						
Home Owners	l	.15	.03	.05	-.05	.07	.08	.57	.33	.18	.16	.15	-.25					
Unemployment	m	.69	.57	.76	.72	-.68	.81	.25	.36	.32	.71	.78	-.80	.25	.25	.72	.40	.36
Mobility	n	.32	.33	.35	-.37	.42	.51	.20	.00	-.49	-.48	-.53	.62	-.72	-.58	-.58	-.19	.68
Doubling Up	o	.18	.10	.11	-.06	.14	-.01	.02	-.22	.16	.14	-.17	.01	.40	.01	.19	.14	.14
Education	u	.62	.63	.73	.70	.65	.81	.05	.30	.44	-.74	-.73	.88	.36	.84	.68	.14	.14

to account for a correlation matrix.<sup>5</sup> The application of the centroid method to the data at hand brought out the fact that the 272 inter-correlations could be expressed in terms of three general factors. Further computations to see if there was a fourth factor indicated that three were sufficient. A three factor solution means that it is possible to regard the three loadings for each variable as coordinates locating that variable as a point with reference to a given sphere. The points inside the sphere were projected to the surface (normalized) and the

CHART I



resulting pattern was studied so as to determine where the three planes of reference should pass. Chart I gives an idea as to the nature of the graphic solution of the problem at hand. The relation of this geometrical figure to the correlation matrix may readily be traced by estimating the angular separation between any two points. Where the angular separation is small, the degree of correlation is high between the normalized variables concerned. An angular separation of 90 degrees shows an absence of relationship or zero correlation between normalized variables, while one of more than 90 degrees shows a negative correlation. (A minus sign on the chart means that the variable has been reflected to the opposite end of the diameter of the sphere through the point.) Chart I shows that variables  $-d$ ,  $e$ ,  $j$ ,  $m$ ,  $-k$ ,  $h$ ,  $-u$ ,  $-s$ ,  $l$ ,  $t$ , and  $f$

<sup>5</sup> The word factor is used in the following technical sense: factors are reference variables in terms of which given variables can be expressed as linear functions. The factor loadings are the coefficients or weights given to the reference variables in the linear function for a particular variable.

tend to fall near a plane which might be passed through the center of the sphere, and through  $m$ , and  $s$ . It is also clear the variables  $a$ ,  $n$ ,  $c$ , and  $b$  are near a plane that could be passed at right angles to the first plane and through the centroid of  $a$ ,  $n$ ,  $c$ . Where the third plane of reference should be cannot be determined without adopting an arbitrary rule. There are no points which indicate a logical solution. For

TABLE IV  
VOTING BEHAVIOR IN CHICAGO: 1930-34  
COORDINATES INSIDE SPHERE<sup>++</sup>  
MATRIX  $FL$  (FACTOR LOADINGS)

		$P$ Traditional Democratic Machine Vote in Poor For- eign-born Areas*	$E$ Home Owners and Opposi- tion to Bond Issue <sup>+</sup>	$D$ Special In- fluences Favor- ing Democratic Candidates In- cluding the Wet Vote**	Communality
	Letter Symbol $z$	$r_{zA_p}$	$r_{zA_e}$	$r_{zA_d}$	$h^2_{III}$
Smith	$a$	.919	-.094	.282	.9329
Lewis	$b$	.669	.094	.623	.8445
Roosevelt	$c$	.898	.043	.411	.9772
Igoe	$n$	.880	.052	.375	.9177
Women	$d$	-.719	-.163	-.060	.5471
Party Voting	$e$	.911	.238	-.053	.8894
Bond Issue	$f$	.493	-.453	-.100	.4582
Wet Vote	$g$	.595	-.323	.388	.6089
Voting Interest	$h$	.356	.341	-.066	.2474
Foreign Birth	$i$	.642	.391	.264	.6347
Catholic Origins	$j$	.810	.274	.046	.7333
Median Rental	$k$	-.752	-.468	.018	.7848
Home Ownership	$l$	-.166	.846	.124	.7586
Unemployment	$m$	.807	.412	.000	.8210
Mobility	$s$	-.371	-.812	.000	.7970
Doubling Up	$t$	-.177	.381	.088	.1842
Education	$u$	-.712	-.617	-.108	.8993
Actual $\Sigma$		5.083	.142	2.232	12.0362
Check $\Sigma$		5.083	.141	2.232	12.0364

\* Distance of variable  $z$  from  $DE$  plane.

+ Distance of variable  $z$  from  $PD$  plane.

\*\* Distance of variable  $z$  from  $PE$  plane.

++ Calculated from centroid co-ordinates inside sphere.

purposes of convenience it was decided to make the third plane orthogonal to the other two. This enables an easy transformation from the coordinates to the original coefficients.<sup>6</sup> Using the three planes described above the loadings given in Table IV were obtained for the seventeen variables.

The next step is to name the factors. Mathematically, the solution

\* Since the factor loadings are derived from the correlation coefficients, it is possible to calculate the correlation between any two variables by employing only the factor loadings. The process of transformation is given by the following equation

$$r = a_{11}a_{21} + a_{12}a_{22} + a_{13}a_{23}$$

where  $a_{11}$  is the loading of variable  $a$  in factor I,  $a_{12}$  is the loading of variable  $a$  in factor II,  $a_{13}$  is the loading of variable  $a$  in factor III, and  $a_{21}$ ,  $a_{22}$ ,  $a_{23}$  represent respectively the loadings of variable  $b$  in factors I, II, and III. Taking an actual example from Table IV, we find that the correlation of the Igoe vote with the Roosevelt vote calculated from the factor loadings is .95 and that the original coefficient is .96.



may be quite satisfactory but its meaning may not be clear. The method does not insure that the factor loadings will be such that they can be readily labelled. The magnitude of the loadings, the signs, and the geometric solution must all be considered when arriving at names for the factors.

The most stable of the planes is the *PE* plane because it has the greatest number of points which are close to it. The distance of any given variable from this plane determines the loading which that variable has in Factor *D*. The highest loadings are Lewis vote (.623), Roosevelt vote (.411), wet vote (.388), Igoe vote (.375), and Smith vote (.282). It is clear that this factor is a highly political one; it represents the extent to which the five variables mentioned have peculiar qualities that distinguish them from the social and economic variables. However, since the loadings are low it means that the political variables were separated from the social and economic variables only to a limited extent. The most independent of all is the Lewis vote and this coincides with the logic of the situation which has already been discussed. There were peculiar influences at work to accentuate the size of the Lewis vote. The other elections also had distinctive political characteristics which marked them off from the other variables. We may therefore name this factor "Special Influences Favoring Democratic Candidates Including the Wet Vote."

Next to the *PE* plane the *PD* plane is the most stable since it has at least four points which are fairly close to it. Distances from this plane, or loadings in Factor *E* as they are called, are given in column two of Table IV. Disregarding signs, the nine highest loadings in the order of their magnitude are home ownership (.846), mobility (−.812), education (−.617), bond issue (−.453), median rental (−.468), unemployment (.412), doubling up (.381), foreign birth (.391), interest in voting (.341). These loadings mean that variations in the proportion of home owners had no definite linear relation to variations in party preferences. In Chicago, home owners are highly tax conscious whether their homes are palatial or extremely modest. While it is hard to combine these descriptions, we may say that Factor *E* represents "Home Owners (many of whom are in poor communities) and Their Opposition to Bond Issues."

Paradoxical as it may seem the factor which has the highest loadings in the solution under discussion is the one which is the least stable. The plane *DE* has few points which are very close to it. Home ownership (*l*) is the nearest and doubling up (*t*) comes next, but it cannot be said that these are sufficient to determine the location of the plane. Chart I shows that there is no point which is close to pole *D* which

marks the intersection of the planes *DE* and *PD*. On the other hand it is obvious that the loadings of the variables in Factor *P* have considerable significance. They show the high degree of relationship between the political variables and the social and economic variables. In the order of their magnitude without regard to signs the highest loadings are: Smith vote (.919), party voting (.911), Roosevelt vote (.898), Igoe vote (.880), religious affiliation (.810), unemployment (.807), median rental (−.752), women (−.719), education (−.712), Lewis vote (.669), foreign birth (.642), wet vote (.595), and bond issue (.493). This factor is obviously the traditional Democratic machine vote which is concentrated in the poor areas where there are many Catholics of foreign extraction and relatively few women voters. We may call this factor the "Traditional Democratic Machine Vote in the Poor Foreign Born Neighborhoods."

According to the multiple factor solution, the Igoe vote more closely resembles the Roosevelt vote than either the Smith vote or the Lewis vote. The slight changes which took place between 1932 and 1934 in the various voting areas of Chicago tended to move the Democratic vote closer to party voting and to the inverse of the ratio of women registered. Since the Igoe vote has a slightly lower loading in Factor *D* than the Roosevelt vote, it can be said that there were fewer special political influences at work in the congressional election. In other words, most of the variations of the Igoe vote can be expressed in terms of Factor *P*, which represents the traditional Democratic machine vote. This factor gives the most general picture of the configuration presented in this study.

An entirely different set of assumptions is involved if it is desired to predict the Igoe vote from the other variables. According to the regression equation technique, the Igoe vote should be expressed as a function of the other variables. This assumes that the independent variables are perfect measures of something or other.<sup>7</sup> While our data do not justify this assumption, the method is nevertheless useful. A logical starting point is the Roosevelt vote since it is so highly correlated with the dependent variable. The regression equation for the Igoe vote as a function of the Roosevelt vote is as follows:  $X_1 = 10.592 + .87905 X_2$ . The main thing that this equation shows is that on the average Igoe got a high percentage of the Roosevelt vote plus a diminishing number of other voters as the Roosevelt vote increased. Where the Roosevelt vote was relatively low, the average gains made by Igoe over the Roosevelt vote were greatest and where the Roosevelt

<sup>7</sup> The solution of partial regression equations by means of determinants brings out this assumption clearly. The figure 1 is used for all diagonal entries. The factorial method uses the highest coefficient in the column for the diagonal entry.

vote was high, Igoe's average gains were least. In fact, in the areas where the Roosevelt vote equalled or excelled 88 per cent one might expect to find an Igoe vote which was equal to or less than the Roosevelt vote. Actually, the scatter diagram shows that there were no such cases. The points which are not close to the regression line indicate some of the influences which account for the 1934 shifts in the Democratic vote. In certain Republican areas which were relatively dry in 1932 there were marked shifts to the Democratic side two years later. Other areas which were strongly Democratic in 1932 did not show any increases in Democratic strength two years later.

Would the addition of other variables to the equation materially increase the closeness of the fit to the Igoe vote? In order to answer this question, the following variables were selected,  $X_w$ , the wet vote,  $X_f$ , per cent foreign born, and  $X_k$ , median rental.<sup>8</sup> An examination of Chart I will show that these variables are not highly intercorrelated with each other. The equation of regression which describes the relationship between the Igoe vote as a dependent variable and the others as independent variables as follows:  $X_n = 14.34614 + .91644X_w - .10765X_f + .03080X_k + .02847X_k$ . The standard error of estimate for this equation ( $S_{n.cik} = 3.30386$ ) is not much lower than that for the equation  $X_n = (f)X_w$ , ( $S_{n.e} = 3.66740$ ). The equation of net regression may be interpreted as meaning that the average change in the Igoe vote for a unit change in the Roosevelt vote, keeping the other variables constant, was very high, whereas the average change in the Igoe vote for unit changes in each of the other variables, keeping the Roosevelt vote and the remaining variables constant, was relatively insignificant.<sup>9</sup> It is interesting to note that the sign of the net regression coefficient for  $X_w$  is negative whereas the sign of  $r_{nw}$  is positive. This reversal of signs means that keeping the Roosevelt vote, foreign birth and median rental constant the net relationship between the Igoe vote and the wet vote was low and inverse.<sup>10</sup> As we have already seen, Igoe won votes among dry Republicans and he did not run quite as well as expected in certain wet Democratic areas.

Since the Igoe vote and the Roosevelt vote are so closely related, the question may be raised as to how the Igoe vote may be explained with-

<sup>8</sup> The regression equations for  $X_n$  on these variables are:

$$X_n = -23.204 + 1.1422 X_w; S_{n.w} = 9.907$$

$$X_n = 42.055 + .7783 X_f; S_{n.f} = 8.461$$

$$X_n = 86.020 - .4141 X_k; S_{n.k} = 9.273$$

<sup>9</sup> The third order coefficients of partial correlation give the same general results. They are:  $r_{nc.gik} = .888$ ;  $r_{nc.cik} = -.141$ ;  $r_{ni.cik} = .066$ ;  $r_{nk.cik} = .109$ . The coefficient of multiple correlation is only slightly higher than  $r_{nc}(R_{n.cik} = .96156)$ .

<sup>10</sup> The standard errors for the coefficients of partial regression indicate that except for the parameter of  $X_w$  we cannot tell whether the signs are positive or negative. The standard errors are:  $b_{nc.gik} = .91644 \pm .040$ ;  $b_{nc.cik} = -.10765 \pm .063$ ;  $b_{ni.cik} = .03080 \pm .039$ ;  $b_{nk.cik} = .02847 \pm .022$ . These standard errors show clearly the overwhelming importance of  $X_w$  in the equation.

out reference to party tradition as measured by previous voting behavior.<sup>11</sup> In other words, what sort of people have acquired the habit of voting Democratic in Chicago? Leaving out the Roosevelt vote, the following equation of net regression was obtained:  $X_n = 6.1028 + .6799X_c + .4675X_i - .1610X_s$ . This equation indicates that the average change in the Igoe vote for a unit change in the wet vote, keeping the other variables constant, was fairly high. The coefficient of net regression for the percentage of foreign-born was lower but significant. On the other hand, economic status as measured by median rental did not add greatly to the accuracy of the estimated Igoe vote when the other variables were held constant.<sup>12</sup> The standard error of estimate for the equation is  $S_{n.gik} = 7.1825$  which is much higher than that for the regression of  $X_n$  on  $X_c$ , and not much lower than that for the regression of  $X_n$  on  $X_i$ . It is interesting to note that signs for the coefficients of net regression in this equation are the same as those for the original zero order coefficients.<sup>13</sup> This means that when the Roosevelt vote is eliminated we cannot perceive the slight shift of voters in relatively dry areas to Igoe.

We are now in a position to consider the relative advantages and disadvantages of the multiple factor and the correlation techniques. The multiple factor method permits the handling of a large number of variables without a great deal of labor. In a preliminary analysis of a given problem it may be very desirable to retain as many variables as possible. If the number of factors obtained is less than four, then it is possible to make a model of the factorial matrix in highly simplified geometric form. Once the meaning of the transformation is understood it is possible to grasp the relationships of the variables very readily. It may happen that the factorial solution will reveal new and significant categories. On the other hand, factor analysis makes it impossible to consider one variable as a dependent variable.<sup>14</sup> In the present problem, the Igoe vote is the only one of the election variables which can be logically considered as a dependent variable. In the fac-

<sup>11</sup> Using variable  $g$  and four others the following equation of net regression was obtained for the Roosevelt vote:  $X_c = 2.6925 + .5428X_g + .2242X_s + .2002X_g + .0253X_i + .1063X_m$ .  $S_{c.ogism} = 3.874$ . It is clear that the net regression coefficient for the Smith vote was the highest. How can we explain the Smith vote? There is no end to this process.

<sup>12</sup> The second order coefficients of partial correlation reverse the order or relative importance of the wet vote and the foreign-born.

$r_{ng,ik} = +.442$

$r_{ni,gh} = +.467$

$r_{nh,gi} = -.297$

<sup>13</sup> The standard errors for the coefficients of partial regression are:  $b_{ng,ik} = .6799 \pm .116$ ;  $b_{ni,gh} = .4675 \pm .074$ ;  $b_{nh,gi} = -.1610 \pm .043$ .  $R_{n.gik} = .8022$ . The  $t$  values for the differences between these coefficients of regression (Fisher, *op. cit.*, pp.150 ff.) show that they are all significant except the difference  $b_{ng,ik} - b_{ni,gh}$  where  $t = 1.4102$ .

<sup>14</sup> The dependent variables are the primary tendencies of the individual group of voters which are to be estimated in terms of the variables given. In other words, the primary factors are the dependent variables. See Thurstone, *op. cit.*, p. 54.

torial analysis it is treated as an independent variable like all of the rest. The factorial method does not guarantee a meaningful solution. It may be impossible to give clear cut definitions to the factors and the solution itself may be indeterminate.

Factorial methods raise another problem. At the present time, the probable errors have not been worked out for factor loadings calculated according to Thurstone's methods. The factors are essentially linear functions of the variates which have certain statistical properties. Since they are obtained from quantities which in themselves are subject to fluctuations, it is contended by some that the first problem is to find sampling distributions and adequate methods for testing the significance of the results obtained. The problem is a very ticklish one. We do not think that the objection should prevent an experimental use of the factorial method. In the present problem where  $n = 147$  and where each of the 147 areas has on the average a population of 10,000 citizens, we were rash enough to see whether the method would yield some categories of significance in political science even before methods were devised to calculate sampling errors. The methods of net regression require the selection of a dependent variable and they permit a more exact analysis of the net relationships with their probable errors.

Both of the methods employed in the present study show that party tradition as measured by previous voting behavior was the most important influence in the 1934 election in Chicago. The method of partial correlation in particular minimizes other influences. The main characteristics of party lines in Chicago, a typical American metropolitan community, were set long before the depression and the New Deal.<sup>15</sup>

<sup>15</sup> The present study has been mainly concerned with the congressional elections of 1934. However the materials also throw light on a number of other topics. In an article which appears elsewhere, one of the authors made the tentative conclusion based on part of the data which appears in this article, that interest in voting as measured by the per cent of adult citizens registered tends to vary inversely with economic status. "Analysis of the 1932 Presidential Vote in Chicago," *Op. cit.* This conclusion was contrary to what he discovered in an earlier study which employed different methods. See H. F. Gosnell *Getting Out the Vote* (Chicago, 1927), p. 117. The addition of the variable mobility reconciles the two studies. It is not that the poor are more interested in voting but the middle income groups living in apartment areas are more transient. A high mobility means that many of the adult citizens do not fulfill residence qualifications for voting, that they are unfamiliar with the location of polling places and that they are more likely to escape the attention of the party workers.

## PRINCIPAL COMPONENTS\*

BY M. A. GIRSHICK  
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THE PROBLEM of analyzing a set of statistical variables into a set of independent variates (i.e. components), which are in a sense to be more fundamental in character, is as much a statistical problem as a mathematical one. The quantities to be analyzed are by their very nature subject to fluctuations and consequently to sampling errors. The same holds true for any function of such quantities. It follows that any solution of this problem, if it is to be of any value, must not only be consistent with certain facts and assumptions in the science of psychology, but must also lend itself to statistical treatment. The truth of the above becomes more evident when it is realized that from the stand point of pure mathematics, the problem lends itself to an infinite number of solutions.

Essentially, there are two questions to which answers must be provided, whatever the method of factoring into components, if that method is to have any meaning. (1) Is the sample of persons that took the test sufficiently large to warrant the statement that more than any specific number  $p(<n)$  components are required to account for the battery of  $n$  tests? (2) Will these components remain stable from one battery of tests to another taken at random? The answer to the first question involves a sampling theory of errors pertaining to a population of *persons*. The second involves a sampling theory of errors pertaining to a population of *tests*.

Professor Hotelling in his paper "Analysis of a Complex of Statistical Variables into Principal Components"<sup>1</sup> has approached the problem of components from essentially this point of view. Not only has he given in this paper a method of obtaining the components, but he has also made substantial contributions to the two types of sampling theories mentioned above.

Professor L. L. Thurstone,<sup>2</sup> in his latest contribution to the theory of components, has been aware of the errors of measurement involved in the problem, but he has not availed himself of the modern theories of sampling distributions and tests of significance developed in recent years by theoretical statisticians under the influence of R. A. Fisher.

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<sup>1</sup> *The Journal of Educational Psychology*, September and October, 1933.

<sup>2</sup> *The Vectors of Mind*, The University of Chicago Press, 1935.

For this reason, the usefulness of the methods he proposes will depend to a great extent on the possibility of constructing sampling theories for testing the results obtained by his methods. In this respect, his centroid method seems to be the most promising. The factor loadings of the first component obtained by the centroid method are continuous functions of the correlations. They can be interpreted as either first approximations to Professor Hotelling's factor loadings (this can be seen by applying the iterative process only once with the initial trial values all equal to unity, and then dividing by  $1/\sqrt{\sum_i \sum_j r_{ij}}$ , or as correlations between each variable and the sum of the variables if the variables are reduced to standard measure. The factor loadings of the other components do not lend themselves to simple interpretations. In fact, the methods of reflection by arbitrarily changing signs in the correlation matrix makes them non-analytic functions of the correlations. This undoubtedly will create difficulties in constructing sampling theories. But it is not at all unlikely that this difficulty will be overcome.

Professor Thurstone criticizes Hotelling's method mainly on two grounds: (1) He objects to the fact that Hotelling uses 1's in the main diagonal of the matrix of correlations instead of communalities. (2) He claims that Hotelling's solution is an artifact because of the assumption that there are as many components as there are tests.

In answer to the first objection, it should be pointed out that Professor Hotelling's contribution to the theory of components does not in the least depend on using 1's in the main diagonal. They are used as a convention and not as an essential part of the theory.

As to the second objection, we shall show in this paper that Hotelling's results can be obtained without making use of the assumption that there are as many components as observed variates. The present derivation is not only independent of this assumption but it is also shorter and requires less knowledge of the theory of equations.

We shall also, in this paper, get the principal components as by-products of the solution to the following two problems: (1) Given a set of variates, to find a linear function of the variates which has least variance ascribable to errors of measurement. (2) To find a linear function of these variates such that the sum of the squares of the correlation between the function and each variate shall be a maximum. The first approach will exhibit a property of the principal components which is of statistical importance, viz., that if all tests have equal reliability coefficients, and therefore equal variances of errors of measurement, then *the first principal component is that linear function of the*

*variates which has least variance resulting from errors of measurement, and among all linear functions of our variates which are uncorrelated with the first component, the second component has least variance resulting from such errors, and so on for the other components. The second approach will emphasize the fact (pointed out by Professor Hotelling) that of all linear functions of the variates, the first principal component has the greatest mean-square correlation with the tests; the second component the next greatest mean-square correlation, etc.*

In the last part of this paper we shall prove that the factor loadings of the principal components are *maximum likelihood statistics*.<sup>3</sup> This fact seems to show that if a set of variates are to be analyzed into components, Hotelling's Principal Axes method is the most efficient one to use; "efficient" having here the technical meaning as defined by R. A. Fisher.

Throughout this paper we shall use the convention that a repeated subscript in the same term stands for summation unless otherwise stated. For instance, instead of writing  $\sum_{j=1}^n a_{ij}x_j$ , we shall simply write  $a_{ij}x_j$ . The range of the repeated subscript will be clear from the context.

# I

Let  $z_1, z_2, \dots, z_n$  be  $n$  statistical variables which have been reduced to "standard measure." The problem is to find a set of uncorrelated variables:  $\gamma_1, \gamma_2, \dots, \gamma_p$ , ( $p \leq n$ ) each of unit variance, such that

$$z_i = a_{ij}\gamma_j \quad (i = 1, 2, \dots, n; \quad j = 1, 2, \dots, p). \quad (1)$$

The following equations follow immediately from (1):

$$Ez_i z_h = r_{ih} = a_{ij}a_{hj} \quad (2)$$

$$Ez_i^2 = \sigma_{ii}^2 = a_{i1}^2 + a_{i2}^2 + \dots + a_{ip}^2, \quad (3)$$

where  $E$  denotes the mathematical expectation or mean value of the expression following.

Let  $S = a_{i1}a_{i1}$ .  $S$  is the sum of the contributions of  $\gamma_1$  to the variance of all  $z$ 's. We shall maximize  $S$  subject to condition (2).

$$\text{Let} \quad 2T = S - \lambda_{ih}a_{ij}a_{hj}$$

where  $\lambda_{ih} (= \lambda_{hi})$  are Lagrange multipliers. Then

$$\frac{\partial T}{\partial a_{i1}} \quad a_{i1} - \lambda_{ih}a_{hi} = 0 \quad (4)$$

<sup>3</sup> A similar proof, but from a different standpoint, was first given by William G. Madow of Columbia University.



$$\frac{\partial T}{\partial a_{ij}} = -\lambda_{ih}a_{hj} = 0 \quad (j \neq 1). \quad (5)$$

We combine (4) and (5) into one equation:

$$\frac{\partial T}{\partial a_{ij}} \quad \delta_{1j}a_{i1} - \lambda_{ih}a_{hj} = 0 \quad (6)$$

where the symbol  $\delta_{ij}$  has the value zero for  $i \neq j$  and 1 for  $i=j$ .

Multiplying (6) by  $a_{i1}$ , summing with respect to  $i$ , and setting  $\sum_i a^2_{i1} = k_1$  we get

$$\delta_{1j}k_1 - \lambda_{ih}a_{i1}a_{hj} = 0.$$

Since  $\lambda_{ih} = \lambda_{hi}$ , we use equation (4) to replace  $\lambda_{ih}a_{i1}$  by  $a_{h1}$ . We thus get

$$a_{h1}a_{hj} = \delta_{1j}k_1. \quad (7)$$

If we multiply (7) by  $a_{mj}$ , sum with respect to  $j$ , and use (2), the result is:

$$r_{hm}a_{h1} - k_1a_{m1} = 0. \quad (8)$$

The rest of the argument is identical with that of Professor Hotelling<sup>4</sup> and need not be repeated here.

To solve for the  $\gamma$ 's in terms of the  $z$ 's it is not necessary to employ Cramer's rule (which method necessarily assumes that there are as many  $\gamma$ 's as there are  $z$ 's), for we can use the following device: Multiply (1) by  $a_{im}$  and sum with respect to  $i$ . This yields

$$a_{im}z_i = a_{im}a_{ij}\gamma_j. \quad (9)$$

Since by (7)  $a_{im}a_{ij} = k_m\delta_{jm}$  (not summed for  $m$ ), equation (9) becomes

$$a_{im}z_i = k_m\gamma_m \quad (\text{not summed for } m),$$

or

$$\gamma_m = a_{im}z_i/k_m. \quad (10)$$

## II

Let  $z_1, z_2, \dots, z_n$  be as above. We shall assume that each test score  $z_i$  is made up of two parts, a true score  $\xi_i$  and a random error  $\epsilon_i$ , where the  $\epsilon_i$  are uncorrelated with each other and with  $\xi_i$ , and are of zero mean. We shall further assume that the variance of the  $\epsilon$ 's is the same for all the tests.

Let  $\gamma$  be any linear function of the  $z$ 's and let  $\sigma'^2$  be that part of the variance of  $\gamma$  which results from the errors of measurement. Then, if  $\gamma$  is given in the form

<sup>4</sup> *Loc. cit.*

$$\gamma = \alpha_i z_i \quad (2.1)$$

it can easily be shown that

$$\sigma'^2 = \sigma^2 \sum_i \alpha_i^2 \quad (2.2)$$

where  $\sigma^2$  is the variance of the random errors.

We now require  $\gamma$  to be that linear function of the  $z$ 's which is of unit variance and for which  $\sigma'^2$  is a minimum. In order to find such a  $\gamma$  we have to minimize the following quantity:

$$\sigma^2 \sum_i \alpha_i^2 - \mu \sum_i \sum_j \alpha_i \alpha_j r_{ij}$$

where

$$\sum_i \sum_j \alpha_i \alpha_j r_{ij} = E\gamma^2 = 1, \quad (2.3)$$

and  $\mu$  is a Lagrange multiplier. The minimizing conditions are

$$\sigma^2 \alpha_i - \mu \alpha_j r_{ij} = 0 \quad (i = 1, 2, \dots, n). \quad (2.4)$$

Let

$$\mu = \sigma^2 / \lambda \quad (2.5)$$

then (2.4) becomes

$$\alpha_j r_{ij} - \lambda \alpha_i = 0. \quad (2.6)$$

For this set of homogeneous linear equations to have a non-trivial solution, it is necessary and sufficient that

$$\begin{vmatrix} 1 - \lambda & r_{12} & r_{13} & \dots & r_{1n} \\ r_{21} & 1 - \lambda & r_{23} & \dots & r_{2n} \\ r_{31} & r_{32} & 1 - \lambda & \dots & r_{3n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ r_{n1} & r_{n2} & r_{n3} & \dots & 1 - \lambda \end{vmatrix} = 0. \quad (2.7)$$

Substituting a simple root of (2.7) into the equations (2.6) we get a family of solutions all of which are proportional to one solution. If we multiply (2.6) by  $\alpha_i$ , sum with respect to  $i$ , and use (2.3), we get

$$1 - \lambda \sum_i \alpha_i^2 = 0. \quad (2.8)$$

This determines the factor of proportionality.

When (2.4) is multiplied by  $\alpha_i$  and the result summed with respect to  $i$ , the result is

$$\sigma'^2 = \mu = \sigma^2 / \lambda.$$

This shows that a large  $\lambda$  corresponds to a small  $\sigma^2$ . It follows therefore that for the solution of our problem we must choose the *largest* root of (2.7). This completes the proof as far as our original problem is concerned.

It is obvious that every distinct root of (2.7) defines a set of  $\alpha$ 's and hence a  $\gamma$ . We thus get a whole set of  $\gamma$ 's which can be expressed as

$$\gamma_i = \alpha_{ij}z_j.$$

We shall now show that these  $\gamma$ 's are precisely the principal components derived in Part I, and thus prove the statement that the first principal component (defined by the largest root of (2.7)) is that linear function of the variates which has least variance ascribable to errors of measurement.

First we prove that the correlation between any two distinct  $\gamma$ 's is zero. Obviously

$$E\gamma_i\gamma_j = \alpha_{ip}\alpha_{ji}Ez_pz_i = \alpha_{ip}\alpha_{ji}r_{pi}.$$

Now, by (2.6)

$$\alpha_{ip}r_{pi} = \lambda_i\alpha_{ii}; \quad \alpha_{jp}r_{pi} = \lambda_j\alpha_{jp} \quad (\text{not summed for } i \text{ or } j).$$

Hence

$$E\gamma_i\gamma_j = \lambda_i(\alpha_{ji}\alpha_{ii}) = \lambda_j(\alpha_{jp}\alpha_{ip}).$$

When  $\lambda_i \neq \lambda_j$ , the above equation can hold only if

$$\alpha_{ii}\alpha_{ji}(\alpha_{ip}\alpha_{jp}) = 0. \quad (2.9)$$

Hence

$$E\gamma_i\gamma_j = 0. \quad (2.10)$$

Equations (2.8) and (2.9) can be combined into the equation

$$\lambda_i\alpha_{ii}\alpha_{ji} = \delta_{ij} \quad (\text{not summed for } i) \quad (2.11)$$

and equations (2.10) and (2.3) can be combined into

$$E\gamma_i\gamma_j = \delta_{ij}.$$

If  $p$  of the roots of (2.7) are equal, the  $\alpha$ 's will not be uniquely determined. However, we can still find  $p$  linearly independent solutions of (2.6) which will satisfy the condition  $\lambda_i d_{ij} d_{ji} = \delta_{ij}$  where the  $p$   $\lambda_i$  are all equal.

If we assume that the determinant  $|r_{ij}|$  is not zero, the determinant of the  $\alpha$ 's,  $|\alpha_{ij}|$ , will also be different from zero. Let  $\alpha_{ij}'$  be the cofactor of  $\alpha_{ij}$  in  $|\alpha_{ij}|$  divided by  $|\alpha_{ij}|$ . Now  $\gamma_i = \alpha_{ij}z_j$ , therefore

$$\alpha^{ik}\gamma_i = \alpha_{ij}\alpha^{ik}z_j = \delta_{jk}z_j = z_k. \quad (2.13)$$

If we multiply (2.11) by  $\alpha^{ik}$  and sum with respect to  $j$ , we get

$$\lambda_i\alpha^{ik}\alpha_{jl}\alpha_{il} = \alpha^{ik}\delta_{ij},$$

or

$$\lambda_i\alpha_{ik} = \alpha^{ik}. \quad (2.14)$$

Substituting this in (2.13) we finally get

$$z_k = \lambda_i\alpha_{ik}\gamma_i. \quad (2.15)$$

Set  $a_{ki} = \lambda_i\alpha_{ik}$  ( $= E\gamma_i z_k$ ) (not summed for  $i$ )  
then

$$z_k = a_{ki}\gamma_i. \quad (2.16)$$

The quantities  $a_{ki}$  satisfy the following equation:

$$a_{ip}a_{iq} = \lambda_p\lambda_q\alpha_{pj}\alpha_{qj} = \lambda_p\delta_{pq}.$$

This follows from the definition and (2.11).

It is obvious that the  $a$ 's are identical with those obtained in Part I. The  $\gamma$ 's are therefore the principal components.

To get the  $\alpha$ 's and the  $\lambda$ 's of Part II we can use the iterative method given by Professor Hotelling.<sup>5</sup> But instead of multiplying the final trial values,  $a_1 \cdots a_n$ , by  $\sqrt{\lambda/\sum_i a_i^2}$  we multiply them by  $1/\sqrt{\lambda\sum_i a_i^2}$ . In other words we get the  $\alpha$ 's or the  $a$ 's depending on whether we multiply the final trial values by  $1/\sqrt{\lambda\sum_i a_i^2}$  or by  $\sqrt{\lambda/\sum_i a_i^2}$ .

### III

Let  $z_1, z_2 \cdots z_n$  be as above. We are going to solve the problem of finding a linear function of the  $z$ 's such that the sum of the squares of the correlations between each  $z$  and the function shall be a maximum. For simplicity of calculation, we shall further require that the variance of the function be unity. Let  $\gamma$  be such a function:

$$\gamma = \alpha_i z_i \quad (3.1)$$

$$E\gamma^2 = \alpha_i\alpha_j E z_i z_j = \alpha_i\alpha_j r_{ij} = 1 \quad (3.2)$$

$$E\gamma z_i = \alpha_i E z_i z_i = \alpha_i r_{ii} \quad (3.3)$$

*Loc. cit.* A method for accelerating the iterative process by a matrix squaring technique is described by H. Hotelling in a paper shortly to appear in *Psychometrika*. Another method of obtaining the Principal Components can be found in T. L. Kelley's *Essential Traits of Mental Life*, Harvard University Press, 1935.

We want to maximize  $\sum_j (\alpha_i r_{ij})^2$  subject to condition (3.2).

Let

$$2T = \sum_j (\alpha_i r_{ij})^2 - \lambda \alpha_i \alpha_j r_{ij}$$

where  $\lambda$  is a Lagrange multiplier. Taking the partial derivative of  $T$  with respect to  $\alpha_i$  and setting the result equal to zero,

$$\frac{\partial T}{\partial \alpha_i} = \alpha_k r_{kj} r_{ij} - \lambda \alpha_k r_{ik} = 0 \quad (3.4)$$

we get a system of homogeneous linear equations in the  $\alpha$ 's. In order that these equations have a non-trivial solution, it is necessary and sufficient that the determinant of the equations,  $|r_{kj} r_{ij} - \lambda r_{ik}|$ , be equal to zero. If the determinant of the correlations,  $|r_{ij}|$ , is zero, the above determinant will be zero identically for all values of  $\lambda$ . This follows from the fact that

$$|r_{kj} r_{ij} - \lambda r_{ik}| = |r_{ij}| \cdot |r_{ij} - \lambda \delta_{ij}|. \quad (3.5)$$

In this case the  $\alpha$ 's of (3.4) are not uniquely defined and consequently the problem has no solution. We shall assume therefore that  $|r_{ij}| \neq 0$ . We multiply (3.4) by  $r^{il}$ , where  $r^{il}$  is the cofactor of  $r_{il}$  in the determinant  $|r_{il}|$  divided by  $|r_{il}|$ , and sum with respect to  $l$ . This yields

$$\alpha_k r_{kj} \delta_{jl} - \lambda \alpha_k \delta_{kl} = 0$$

or

$$\alpha_k r_{kl} - \lambda \alpha_l = 0. \quad (3.6)$$

The  $\alpha$ 's can now be determined from these equations, and as above, the solution will be non-trivial if and only if

$$|r_{ij} - \lambda \delta_{ij}| = 0. \quad (3.7)$$

Substituting a simple root of (3.7) into the equations (3.6) we get a family of solutions all of which are proportional to one solution. If we multiply (3.6) by  $\alpha_l$  and sum with respect to  $l$ , we get

$$1 - \lambda \sum_i \alpha_i^2 = 0. \quad (3.8)$$

This determines the factor of proportionality.

When (3.4) is multiplied by  $\alpha_i$  and the result summed with respect to  $i$ , we get

$$\sum_j (\alpha_k r_{kj})^2 = \lambda.$$

This shows that the quantity we want to maximize is equal to one of the roots of (3.7). Hence for the solution of our problem, we choose the largest root of (3.7).

The rest of the argument is identical with that of Part II.

In deriving the components by the second and third methods, we had to assume that  $|r_{ii}| \neq 0$ . A similar situation would arise if we attempted to solve for the  $z$ 's in Part I from equation 10. While it is possible in Part I to solve for the  $\gamma$ 's in terms of the  $z$ 's without this assumption, it is impossible to reverse the process. This apparent inconsistency is explained by the fact that in the first case we have more equations than unknowns but they happened to be consistent, in the second case we have more unknowns than equations and the solution cannot therefore be unique.

#### IV

Let  $x_1, x_2, \dots, x_s$  be a set of variates having a multivariate normal distribution. We wish to find a linear function of these  $x$ 's such that the sum of the squares of the correlations between each  $x$  and the function shall be a maximum. It is obvious that the solution of this problem for the *population* will parallel step by step the one obtained in Part III for a *sample*. We will thus get for the population a set of linear functions  $\gamma_1, \gamma_2, \dots, \gamma_s$  such that

$$\gamma_i = \alpha_{i,j} x_j \quad (4.1)$$

$$E\gamma_i \gamma_j = \delta_{ij} \quad (4.2)$$

$$\alpha_{i,p} \sigma_{pq} - \lambda_i \alpha_{i,q} = 0 \quad (\text{not summed for } i) \quad (4.3)$$

$$\lambda_i \alpha_{i,p} = \alpha^{ip} \quad (\text{not summed for } i) \quad (4.4)$$

where  $\sigma_{pq} = E x_p x_q$  and  $\alpha^{ip} = (\text{cofactor of } \alpha_{i,p}) / |\alpha_{i,p}|$ .

It is easy to show that the distribution of the  $\gamma$ 's will be given in the form:

$$\frac{1}{(2\pi)^{1/2}} \exp \left( -\frac{1}{2} \sum_{i=1}^s \gamma_i^2 \right) d\gamma_1 \cdots d\gamma_s.$$

If we perform the linear transformation (4.1) on the  $\gamma$ 's, we get the distribution of the  $x$ 's in the form:

$$\frac{|\alpha_{ij}|}{(2\pi)^{1/2}} \exp \left( -\frac{1}{2} \alpha_{i,p} \alpha_{i,q} x_p x_q \right) dx_1 \cdots dx_s.$$

Let  $s_{ij} = S(x_{ia} x_{ja}) / n$ , where  $S$  stands for summation over the sample. The distribution density for the sample is then given by

$$\frac{|\alpha_{ij}|^n}{(2\pi)^{1/2n}} \exp \left( -\frac{1}{2} n \alpha_{ip} \alpha_{iq} s_{pq} \right).$$

We shall now estimate the  $\alpha$ 's by the method of maximum likelihood. We take the partial derivative of

$$n \log |\alpha_{ij}| - \frac{1}{2} n \alpha_{ip} \alpha_{iq} s_{pq}$$

with respect to  $\alpha_{ip}$  and set the result equal to zero. This yields

$$\alpha_{ip} - \alpha_{iq} s_{pq} = 0.$$

But by (4.4)  $\alpha_{ip} = \lambda_i \alpha_{ip}$ . Hence, the maximum likelihood estimates of the  $\alpha$ 's is given by the equations

$$\alpha_{iq} s_{pq} - \lambda_i \alpha_{ip} = 0.$$

This equation is the same as (3.6) with  $s_{pq}$  substituted for  $r_{pq}$ . Hence we have shown *that the  $\alpha$ 's and therefore the  $a$ 's are maximum likelihood statistics.*

## THE NEGRO AS A FACTOR IN THE NATION'S LABOR FORCE

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FOR MANY decades large numbers of Negroes have engaged in gainful occupations in the United States. They have helped produce its wealth, and they have had an important part in its social and economic life. What proportion of the Negroes are gainfully occupied? How important a factor are they in the nation's labor force today? How are they distributed over the occupational field, and what is their social-economic status? What has the future in store for the Negro workers? As the years pass, will a larger or a smaller proportion of them engage in gainful labor, and will they become a more or a less important factor in the labor force of the nation? What changes will take place in their occupational and their industrial distribution, and what changes in their social-economic status? If, with the further mechanization of industry, the machine takes over much of the unskilled work they are now doing, will they be able to rise to higher pursuits, or will they replace white workers in the remaining unskilled pursuits, or, finally, will they largely fall into that permanently unemployed class certain writers have prophesied that we shall have in the future? These questions are of vital importance, not only to Negro workers and the Negro race but also to workers in general, to employers and to society at large. They merit careful study by the statistician, the sociologist, and the public welfare specialist.

In 1930, 5,503,535 Negroes—3,662,893 males and 1,840,642 females—10 years old and over were engaged in gainful occupations, and they comprised 59.2 per cent of the Negro population 10 years old and over. The proportion of the population 10 years old and over gainfully occupied in 1930 was higher for Negroes (59.2 per cent) than for either native whites (47.0 per cent) or foreign-born whites (56.1 per cent). This fact is accounted for largely by the relatively large proportion of Negro females 10 years old and over gainfully occupied—38.9 per cent, as compared with 20.5 per cent of the native white females and with 18.8 per cent of the foreign-born white females. The proportion of males 10 years old and over gainfully occupied in 1930 was 80.2 per cent for Negroes as compared with 73.4 per cent for native whites, and with 88.4 per cent for foreign-born whites.<sup>1</sup>

<sup>1</sup> 1930 Census, *General Report on Occupations*, p. 74. The term "gainfully occupied," as used in



The proportion of single women 15 years old and over gainfully occupied in 1930 was not much higher for Negroes (52.1 per cent) than for native whites (48.7 per cent) and was not nearly as high for Negroes as for foreign-born whites (73.8 per cent). The proportion of married women and also the proportion of widowed and divorced women 15 years old and over gainfully occupied in 1930, however, was far higher for Negroes than for any other population class. Thus, 33.2 per cent of the married Negro women were gainfully occupied, as compared with only 9.8 per cent of the married native white women and with only 8.5 per cent of the married foreign-born white women; and 65.0 per cent of the widowed and divorced Negro women were gainfully occupied, as against 31.9 per cent of the widowed and divorced native white women and 21.1 per cent of the widowed and divorced foreign-born white women. In the broad age period 25 to 44 years, 35.9 per cent of the Negro married women and 81.6 per cent of the Negro widowed and divorced women were gainfully occupied in 1930.<sup>2</sup>

The foregoing statistics show that the married and the widowed and divorced Negro women are gainfully employed much more nearly up to the employable limit than are the white women of these classes, and hence, that there is less room for increase in the proportion of the Negro married and widowed and divorced women than in the proportion of the white married and widowed and divorced women engaged in gainful occupations.

How important a factor are Negroes in the nation's labor force? In 1930, Negroes formed 11.3 per cent of all gainful workers—9.6 per cent of all male workers and 17.1 per cent of all female workers. The relative importance of Negroes in the Nation's labor force appears to have been decreasing gradually, however, since they formed 14.3 per cent of all workers in 1890, 13.7 per cent in 1900, 13.6 per cent in 1910, and 11.6 per cent in 1920.<sup>3</sup>

*Occupational classes.* Two main classes of occupations—agricultural pursuits and domestic and personal service pursuits—have always furnished employment to a very large proportion of the Negro gainful workers. In 1930 not far from two-thirds (64.8 per cent) of the 5,503,535 Negroes engaged in gainful occupations were in these occupations—36.1 per cent in agricultural pursuits, and 28.6 per cent in domestic

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census occupation statistics, includes all persons who usually work at a gainful occupation, even though not at work at the time of the enumeration; and a "gainful occupation," in census usage, is an occupation by which the person who pursues it earns money or a money equivalent or assists in the production of marketable goods. The term "gainful worker" does not include women doing housework in their own homes, without wages, and having no other employment, nor children working at home, merely on general housework, on chores, or at odd times on other work.

<sup>2</sup> *Ibid.*, p. 274.

<sup>3</sup> *Ibid.*, pp. 74, 75; 1900 Census, *Report on Occupations*, p. lxxii.

and personal service pursuits. Next in importance were manufacturing and mechanical pursuits with 18.6 per cent of the Negro workers. Transportation and communication pursuits gave employment to 7.2 per cent of the Negro workers, pursuits in trade to 3.3 per cent, and professional service to 2.5 per cent. The remaining Negro workers, comprising only 3.6 per cent of the total, were distributed among the other main classes of occupations—forestry and fishing (0.6 per cent), extraction of minerals (1.4 per cent), public service, not elsewhere classified (0.9 per cent), and clerical occupations (0.7 per cent).<sup>4</sup>

*Social-economic groups.* The position occupied by Negroes in the nation's labor force, and also their social-economic status, can be shown best by grouping the Negro gainful workers into a few large social-economic groups, such as professional persons; proprietors, managers, and officials; clerks and kindred workers; skilled workers; semiskilled workers; and unskilled workers. Such a grouping largely cuts across industry lines and brings together into one large group all of the workers belonging to the same social-economic class, without particular reference to the different occupations the workers may be pursuing. In Table I, the occupations of the Negro gainful workers of the United States have been classified into social-economic groups for each of the three census years, 1910, 1920, and 1930.<sup>5</sup>

Professional persons—group 1—formed only a very small proportion (2.1 per cent) of all Negro workers in 1930. While proprietors, managers, and officials—group 2—constituted 16.9 per cent of the total, most of those in this group were either farm owners or farm tenants. Clerks and kindred workers, the so-called "white-collar workers"—group 3—formed only 1.5 per cent of the total. These workers comprise office assistants, sales people, telegraph and telephone operators, and all others doing the various types of clerical and kindred work.

Skilled workers and foremen—group 4—comprise foremen and the followers of skilled trades, such as carpenters, machinists, plumbers, etc. In this group are included those occupations for the pursuance of which a long period of training or an apprenticeship usually is necessary, and which in their pursuance call for a degree of judgment and manual dexterity, one or both, above that required in semiskilled occupations. In 1930, skilled workers and foremen formed only 3.2 per cent of all Negro gainful workers.

Semiskilled workers—group 5—include machine tenders, workers in the needle trades, and, in general, workers in those manual pursuits for the pursuance of which only a short period or no period of training

<sup>4</sup> 1930 Census, *General Report on Occupations*, p. 74.

<sup>5</sup> For the occupations included in each group, see this JOURNAL, Vol. XXVIII, No. 184 (Dec. 1933), pp. 379-382.

is necessary, and which in their pursuance call for only a moderate degree of judgment or of manual dexterity. Of all Negro workers in 1930, 9.4 per cent were in semiskilled occupations.

TABLE I  
NEGRO GAINFUL WORKERS IN THE UNITED STATES CLASSIFIED INTO  
SOCIAL-ECONOMIC GROUPS, BY SEX: 1910 TO 1930

Sex and group	Number			Per cent distribution		
	1930	1920	1910	1930	1920	1910
<b>TOTAL</b>	<b>5,503,535</b>	<b>4,824,151</b>	<b>5,192,535</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
1. PROFESSIONAL PERSONS	115,765	77,118	64,648	2.1	1.6	1.2
2. PROPRIETORS, MGRS., & OFFICIALS	929,644	973,253	923,404	16.9	20.2	17.8
2-a Farmers (owners and tenants)	873,653	932,050	883,408	15.9	19.3	17.0
2-b Wholesale and retail dealers	28,343	23,593	20,894	0.5	0.5	0.4
2-c Other proprs., mgrs., and off.	27,648	17,610	19,102	0.5	0.4	0.4
3. CLERKS AND KINDRED WORKERS	82,669	63,095	38,698	1.5	1.3	0.7
4. SKILLED WORKERS AND FOREMEN	176,912	150,428	115,300	3.2	3.1	2.2
5. SEMISKILLED WORKERS	515,381	369,761	258,258	9.4	7.7	5.0
5-a Semiskilled workers in mfg.	181,079	161,892	107,869	3.3	3.4	2.1
5-b Other semiskilled workers	334,302	207,869	150,389	6.1	4.3	2.9
6. UNSKILLED WORKERS	3,683,164	3,190,496	3,792,227	66.9	66.1	73.0
6-a Farm laborers	1,112,510	1,198,140	1,949,848	20.2	24.8	37.6
6-b Factory & bldg. const. laborers	674,187	601,295	438,327	12.3	12.5	8.4
6-c Other laborers	516,414	446,154	389,956	9.4	9.2	7.5
6-d Servant classes	1,380,053	944,907	1,014,096	25.1	19.6	19.5
<b>MALE</b>	<b>3,662,893</b>	<b>3,252,862</b>	<b>3,178,554</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
1. PROFESSIONAL PERSONS	55,610	39,434	35,815	1.5	1.2	1.1
2. PROPRIETORS, MGRS., & OFFICIALS	842,920	885,385	836,852	23.0	27.2	26.3
2-a Farmers (owners and tenants)	797,231	851,621	803,477	21.8	26.2	25.3
2-b Wholesale and retail dealers	24,493	20,455	17,888	0.7	0.6	0.6
2-c Other proprs., mgrs., and off.	21,196	13,309	15,467	0.6	0.4	0.5
3. CLERKS AND KINDRED WORKERS	62,138	48,047	31,926	1.7	1.5	1.0
4. SKILLED WORKERS AND FOREMEN	175,537	148,551	114,269	4.8	4.6	3.6
5. SEMISKILLED WORKERS	329,374	228,806	148,579	9.0	7.0	4.7
5-a Semiskilled workers in mfg.	104,441	91,817	53,430	2.9	2.8	1.7
5-b Other semiskilled workers	224,933	136,989	95,149	6.1	4.2	3.0
6. UNSKILLED WORKERS	2,197,314	1,902,639	2,011,113	60.0	58.5	63.3
6-a Farm laborers	693,669	667,317	979,354	18.9	20.5	30.8
6-b Factory & bldg. const. laborers	650,925	567,311	425,307	17.8	17.4	13.4
6-c Other laborers	508,754	438,157	386,263	13.9	13.5	12.2
6-d Servant classes	343,966	229,854	220,189	9.4	7.1	6.9
<b>FEMALE</b>	<b>1,840,642</b>	<b>1,571,289</b>	<b>2,013,981</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
1. PROFESSIONAL PERSONS	60,155	37,684	28,833	3.3	2.4	1.4
2. PROPRIETORS, MGRS., & OFFICIALS	86,724	87,868	86,552	4.7	5.6	4.3
2-a Farmers (owners and tenants)	76,422	80,429	79,931	4.2	5.1	4.0
2-b Wholesale and retail dealers	3,850	3,138	3,006	0.2	0.2	0.1
2-c Other proprs., mgrs., and off.	6,452	4,301	3,615	0.4	0.3	0.2
3. CLERKS AND KINDRED WORKERS	20,531	15,048	6,772	1.1	1.0	0.3
4. SKILLED WORKERS AND FOREMEN	1,375	1,877	1,031	0.1	0.1	0.1
5. SEMISKILLED WORKERS	186,007	140,955	109,679	10.1	9.0	5.4
5-a Semiskilled workers in mfg.	76,638	70,075	54,439	4.2	4.5	2.7
5-b Other semiskilled workers	109,369	70,880	55,240	5.9	4.5	2.7
6. UNSKILLED WORKERS	1,485,850	1,287,857	1,781,114	80.7	82.0	88.4
6-a Farm laborers	41,841	530,823	970,494	22.8	33.8	48.2
6-b Factory & bldg const. laborers	23,262	33,984	13,020	1.3	2.2	0.6
6-c Other laborers	7,660	7,997	3,693	0.4	0.5	0.2
6-d Servant classes	1,036,087	715,053	793,907	56.3	45.5	39.4

The unskilled workers—group 6—include the workers in those occupations for the pursuance of which no special training, judgment, or manual dexterity is required, since the workers supply mainly muscular strength for the performance of coarse, heavy, work. In 1930, more than two-thirds (66.9 per cent) of the Negro gainful workers were unskilled.

The skilled, the semiskilled, and the unskilled are all manual workers. Almost 8 out of 10 (79.5 per cent) of the Negro workers in 1930 were in these three groups. It is quite probable, also, that most of the Negro farm owners and farm tenants are actually engaged in manual labor, and that the Negro croppers, in the work they do, do not differ greatly from farm laborers. If the Negro farm owners and tenants be considered manual workers, then, in 1930, more than 95 out of each 100 (95.4 per cent) of the Negro workers were engaged in manual work; and if the 392,897 Negro croppers be considered unskilled, then, in 1930, 74.1 per cent of the Negro workers were in unskilled pursuits.

During the 20-year period from 1910 to 1930, significant changes were taking place in the social-economic distribution of Negro gainful workers (see Table I). Professional persons; proprietors, managers, and officials (other than farmers); and skilled workers and foremen increased considerably in relative importance, while the relative importance of clerks and kindred workers more than doubled and the relative importance of semiskilled workers nearly doubled. But farmers were relatively less important in 1930 than in 1910, and there was a striking decline in the relative importance of farm laborers—from 37.6 to 20.2 per cent of all Negro workers. There was a considerable increase, however, in the relative importance of nonagricultural laborers and in the relative importance of the servant classes. There was a marked increase in the proportion of the Negro female workers engaged in professional pursuits, in clerical and kindred pursuits, and in servant pursuits, respectively.

If professional persons; proprietors, managers, and officials (exclusive of farmers); and clerks and kindred workers—the head workers—be combined, it develops that the proportion of the total Negro workers in these three groups increased from 2.8 per cent in 1910 to 4.6 per cent in 1930. The skilled workers and the semiskilled workers, combined, increased from 7.2 to 12.6 per cent of the total during the two decades. But notwithstanding the fact that during this 20-year period there was a gradual and important movement of Negro workers into higher social-economic groups, at the close of the period over two-thirds of them (66.9 per cent) were still in unskilled pursuits—6 out of 10 of the males and over 8 out of 10 of the females. And, as already stated, to the 66.9 per cent classified in Table I as being unskilled in 1930 doubtless might properly be added, as being likewise unskilled, the 392,897 Negro croppers, who formed 7.1 per cent of all Negro workers in 1930.

Very significant changes have been taking place in the relative importance of Negroes in the nation's labor force and in the occupational

and the social-economic distribution of Negro workers. These changes, together with prospective changes in industrial organization and the probable further mechanization of industry, indicate that future years will bring even more significant changes in the relative importance of Negro workers, in their occupational distribution, and in their social-economic status. What has the future in store for Negro workers?

*Relative importance of Negro workers.* At the first census of the United States, that of 1790, Negroes formed 19.3 per cent of the total population. At each succeeding census, however, except that of 1810, Negroes formed a smaller proportion of the total population. In 1930, they constituted only 9.7 per cent of the total.<sup>6</sup> During each decade comprised in the half century from 1880 to 1930, the per cent of increase in population was smaller for Negroes than for whites.<sup>6</sup> Thus, past trends appear to indicate that the relative importance of Negroes in the total population may continue to decrease, though possibly not so rapidly as in the past. The proportion Negroes formed of all gainful workers decreased somewhat gradually from 14.3 per cent in 1890 to 11.3 per cent in 1930,<sup>7</sup> and the population statistics, together with the occupation statistics, indicate that the relative importance of Negroes in the nation's labor force will continue to decline.

*Distribution among occupational classes.* During the 20-year period from 1910 to 1930 striking changes took place in the distribution of Negro workers among the main classes of occupations. The proportion engaged in agriculture decreased from 54.6 per cent to 36.1 per cent, and there was some decrease in the proportion engaged in forestry and fishing. The proportion in each of the other main classes of occupations increased, the increase being particularly large in manufacturing (from 12.6 to 18.6 per cent), in public service (from 0.4 to 0.9 per cent), in professional service (from 1.3 to 2.5 per cent), and in clerical occupations (from 0.4 to 0.7 per cent). Numerically, by far the largest increase was in manufacturing—368,750.<sup>8</sup>

In 1930, 76.5 per cent of the Negro gainful workers lived in the South, and of the Negro gainful workers in the South, 47.2 per cent were engaged in agriculture. A very large proportion of the Negro agricultural workers in the South are engaged in raising cotton. Until the last few years the center of cotton production was moving rapidly westward—rapidly away from the old cotton-growing States of the South and toward the newer States of Texas and Oklahoma.<sup>9</sup> While

<sup>6</sup> 1930 Census, *General Report on Population*, p. 32.

<sup>7</sup> 1930 Census, *General Report on Occupations*, p. 74; 1900 Census, report on *Occupations*, p. lxxxii.

<sup>8</sup> 1930 Census, *General Report on Occupations*, pp. 74 and 75.

<sup>9</sup> Between 1914 and 1929 the cotton acreage of South Carolina, Georgia, and Alabama shrank from 12.3 million to 10.0 million acres, while there was an expansion from 14.8 to 22.0 million acres of cotton in Texas and Oklahoma, *American Economic Review*, Vol. XX, No. 1, (March, 1930) p. 118.

current statistics indicate that this westward movement has been arrested, it may stop for a short period only. The Old South, in competition with Texas and Oklahoma, is handicapped, (1) by a depleted soil that necessitates the use of expensive fertilizers, (2) in some sections by a topography that requires terracing to prevent erosion, (3) in many sections by small or terraced fields that are not well adapted to extensive cultivation with large-scale labor-saving machinery, and (4) by a climate in which both the boll weevil and the weed thrive and must be held in check at considerable expense. While this handicap is partially offset by insufficient rainfall and occasional drouth in the west and the consequent smaller yield per acre there, the cost of production, is, nevertheless, considerably lower in the West than in the South.

Along with the shift in the location of the cotton growing industry has gone a striking change in the methods of production. While the Negro, the mule, and the one-mule plow, so common on the old cotton plantations, are there beginning to give place to improved machinery, on the large farms of Texas and Oklahoma the tractor, the gang plow, and the multiple-row cultivator are already in common use; and in these newer fields the mechanical cotton picker threatens to displace the hand picker.

With the probable future rapid increase in the use of machinery in agriculture, particularly in cotton growing, and with the possible renewal of the western trend of the center of cotton production, it seems quite likely that the proportion of the Negro workers engaged in agriculture will continue to decrease rapidly, and that there will be a continued increase in the proportion of them engaged in some of the other occupational fields. And since the South is and for many years probably will continue to be devoted largely to agriculture, it seems quite likely that, in quest of employment in other fields, large numbers of Negro workers will in future years migrate from the South to other sections of the country. Such a migration, to the extent that it became extensive, would mean a geographical redistribution of the Negro population; and it would bring to other sections of the country Negro population, occupation, political, and social problems which, for the most part, have been confined to the South.

*Changes in social-economic groups.* What do present trends indicate as to future changes in the social-economic status of Negro gainful workers? The unskilled have always formed a very large proportion of the Negro workers, and today the great mass of them are in unskilled occupations. "Mechanization probably has advanced most rapidly in the field of unskilled labor; and probably this will be the

field of its greatest future development. More and more the unskilled workers compete with the latent energy stored in a lump of coal or in a gallon of oil or of gasoline, or in the force of gravity exerted through the streams and the tides."<sup>10</sup>

It seems quite probable that the machine will gradually take over and do much of the work now being done by unskilled Negro workers. Should the further mechanization of industry largely displace the Negroes in their present unskilled occupations, what will become of them? Evidently, a large proportion of them must either advance to higher occupations, take over unskilled work being done by white laborers, or else be without work.

Will the Negro workers, as a class, be able to enter or to advance to higher occupations as rapidly as the increase in the mechanization of industry and the improvement in technological processes take from them the unskilled work most of them are now doing?

While the proportion of Negro workers engaged in professional pursuits; proprietary, official, and supervisory pursuits (except farmers); clerical pursuits; skilled pursuits; and semiskilled pursuits has been increasing (see Table I), this increase has not been rapid—only from 10 per cent of all Negro workers in 1910 to 17.2 per cent in 1930. And while the proportion of unskilled among Negro workers has been decreasing, this decrease has been less rapid than has the corresponding decrease among other workers. Thus, the proportion of unskilled among Negro workers (not including croppers) decreased from 73.0 per cent in 1910 to 66.9 per cent in 1930, while the proportion of unskilled among other workers decreased from 31.7 per cent in 1910 to 23.8 per cent in 1930. In 1930, the proportion unskilled was over three times as large among Negro workers as among native white workers.

To what extent is the large proportion of Negro workers in unskilled occupations due to the fact that they largely live in the South,<sup>11</sup> where much of the work is unskilled and where prejudice against Negroes' training for and entering higher pursuits may be stronger than in other sections of the country?

Between 1910 and 1930, a large number of Negro workers migrated from the South to northern cities. Since these Negroes probably included a much smaller proportion of children and of old persons than did the Negro workers of the South, it might be expected that the proportion of the workers engaged in unskilled pursuits would be considerably smaller among the Negroes of the North than among those of the South, even without allowance for any greater freedom the Negroes

<sup>10</sup> Present writer, *Annals of the American Academy of Political and Social Science*, Vol. 184 (Mar. 1936), p. 19.

<sup>11</sup> As stated on p. 534, 76.5 per cent of the Negro gainful workers lived in the South in 1930.

of the North may have had in advancing to higher occupations. What do the statistics show? The Negro gainful workers in each of four Northern cities—Chicago, Detroit, Manhattan Borough of New York,

TABLE II  
NEGRO GAINFUL WORKERS CLASSIFIED INTO SOCIAL-ECONOMIC GROUPS, BY SEX,  
FOR THE UNITED STATES, FOR FOUR NORTHERN CITIES AND FOUR SOUTHERN  
CITIES: 1930  
(Percentage not shown where less than 0.1)

Sex and group	United States		Northern Cities		Southern Cities	
	Number	Per cent	Number	Per cent	Number	Per cent
<b>TOTAL</b>	<b>5,503,535</b>	<b>100.0</b>	<b>449,118</b>	<b>100.0</b>	<b>218,683</b>	<b>100.0</b>
1. PROFESSIONAL PERSONS	115,765	2.1	11,788	2.6	5,540	2.5
2. PROPRIETORS, MGRS., & OFFICIALS	929,644	16.9	8,188	1.8	3,870	1.8
2-a Farmers (owners and tenants)	873,633	15.9	201	—	442	0.2
2-b Wholesale and retail dealers	28,343	0.5	4,116	0.9	2,076	0.9
2-c Other proprs., mgrs., and off.	27,648	0.5	3,869	0.9	1,352	0.6
3. CLERKS AND KINDRED WORKERS	82,669	1.5	23,742	5.3	4,936	2.3
4. SKILLED WORKERS AND FOREMEN	176,912	3.2	28,561	6.4	13,859	6.3
5. SEMISKILLED WORKERS	515,381	9.4	92,407	20.6	40,020	18.3
5-a Semiskilled workers in mfg.	181,079	3.3	39,068	8.7	12,156	5.6
5-b Other semiskilled workers	334,302	6.1	53,409	11.9	27,864	12.7
6. UNSKILLED WORKERS	3,683,164	66.9	284,374	63.3	150,458	68.8
6-a Farm laborers	1,112,510	20.2	783	0.2	2,132	1.0
6-b Factory & bldg. const. laborers	674,187	12.3	66,002	14.7	30,188	13.8
6-c Other laborers	516,414	9.4	46,129	10.3	30,800	14.1
6-d Servant classes	1,380,053	25.1	171,460	38.2	87,338	39.9
<b>MALE</b>	<b>3,662,893</b>	<b>100.0</b>	<b>288,035</b>	<b>100.0</b>	<b>128,549</b>	<b>100.0</b>
1. PROFESSIONAL PERSONS	55,610	1.5	7,261	2.5	2,358	1.8
2. PROPRIETORS, MGRS., & OFFICIALS	842,920	23.0	7,147	2.5	3,248	2.5
2-a Farmers (owners and tenants)	797,231	21.8	196	0.1	406	0.3
2-b Wholesale and retail dealers	24,493	0.7	3,780	1.3	1,840	1.4
2-c Other proprs., mgrs., and off.	21,196	0.6	3,171	1.1	1,002	0.8
3. CLERKS AND KINDRED WORKERS	62,138	1.7	18,567	6.4	3,689	2.9
4. SKILLED WORKERS AND FOREMEN	175,537	4.8	28,132	9.8	13,771	10.7
5. SEMISKILLED WORKERS	329,374	9.0	47,972	16.7	26,459	20.6
5-a Semiskilled workers in mfg.	104,441	2.9	18,281	6.3	7,216	5.6
5-b Other semiskilled workers	224,933	6.1	29,691	10.3	19,243	15.0
6. UNSKILLED WORKERS	2,197,314	60.0	178,956	62.1	79,024	61.5
6-a Farm laborers	693,669	18.9	768	0.3	1,931	1.5
6-b Factory & bldg. const. laborers	650,925	17.8	64,771	22.5	28,935	22.5
6-c Other laborers	508,754	13.9	45,196	15.7	30,131	23.4
6-d Servant classes	343,966	9.4	68,221	23.7	18,027	14.0
<b>FEMALE</b>	<b>1,840,642</b>	<b>100.0</b>	<b>161,083</b>	<b>100.0</b>	<b>90,134</b>	<b>100.0</b>
1. PROFESSIONAL PERSONS	60,155	3.3	4,527	2.8	3,182	3.5
2. PROPRIETORS, MGRS., & OFFICIALS	86,724	4.7	1,039	0.6	622	0.7
2-a Farmers (owners and tenants)	76,422	4.2	5	—	36	—
2-b Wholesale and retail dealers	3,850	0.2	336	0.2	236	0.3
2-c Other proprs., mgrs., and off.	6,452	0.4	698	0.4	350	0.4
3. CLERKS AND KINDRED WORKERS	20,531	1.1	5,175	3.2	1,247	1.4
4. SKILLED WORKERS AND FOREMEN	1,375	0.1	429	0.3	88	0.1
5. SEMISKILLED WORKERS	186,007	10.1	44,495	27.6	13,561	15.0
5-a Semiskilled workers in mfg.	76,638	4.2	20,777	12.9	4,940	5.5
5-b Other semiskilled workers	109,369	5.9	23,718	14.7	8,621	9.6
6. UNSKILLED WORKERS	1,485,850	80.7	105,418	65.4	71,434	79.3
6-a Farm laborers	418,841	22.8	15	—	201	0.2
6-b Factory & bldg. const. laborers	23,262	1.3	1,231	0.8	1,253	1.4
6-c Other laborers	7,660	0.4	933	0.6	669	0.7
6-d Servant classes	1,036,087	56.3	103,239	64.1	69,311	76.9

and Philadelphia—and those in each of four Southern cities—Atlanta, Birmingham, Memphis, and New Orleans—were classified into social-economic groups. The results are presented in Table II.



The percentages given in Table II show that in 1930 there were some real differences between the Northern cities and the Southern cities in the social-economic distribution of Negro workers. These differences were not the same for each sex, however. The proportion of the males engaged in professional pursuits was considerably larger in the Northern than in the Southern cities, but the reverse was true of the females. In the case of each sex, the proportion in clerical pursuits was much larger in the Northern than in the Southern cities. It is interesting to note that the proportion of the male workers in skilled pursuits and in semiskilled pursuits was smaller in the Northern than in the Southern cities, and that the reverse was true of female workers. The proportion of the workers engaged in unskilled pursuits was somewhat higher

TABLE III  
NUMBER AND PROPORTION OF NEGRO GAINFUL WORKERS UNSKILLED, BY SEX,  
FOR THE UNITED STATES, FOR FOUR NORTHERN CITIES AND FOUR SOUTHERN  
CITIES: 1930

Area	Male			Female		
	Total workers	Unskilled workers		Total workers	Unskilled workers	
		Number	Per cent		Number	Per cent
United States	3,662,893	2,197,314	60.0	1,840,642	1,485,850	80.7
Four Northern Cities	288,035	178,956	62.1	161,083	105,418	65.4
Chicago, Ill.	85,046	50,934	59.9	44,421	25,827	58.1
Detroit, Mich.	44,916	29,598	65.9	15,381	11,178	72.7
Manhattan Borough, N. Y.	81,912	48,421	59.1	58,552	36,551	62.4
Philadelphia, Pa.	76,161	50,003	65.7	42,729	31,862	74.6
Four Southern Cities	128,549	79,024	61.5	90,134	71,434	79.3
Atlanta, Ga.	26,332	15,684	59.6	24,285	19,766	81.4
Birmingham, Ala.	30,932	18,772	60.7	18,067	14,446	80.0
Memphis, Tenn.	31,773	20,493	64.5	20,251	15,855	78.3
New Orleans, La.	39,512	24,075	60.9	27,531	21,367	77.6

for males in the Northern than in the Southern cities, but was much higher for females in the Southern than in the Northern cities. As shown by Table III, the proportion in unskilled pursuits was particularly high for males in Detroit and Philadelphia and for females in Atlanta and Birmingham. In each group of cities, and in 5 of the 8 cities taken separately, the proportion of males in unskilled work, if croppers be omitted, was higher than in the United States as a whole. If, however, croppers be classed as unskilled then the proportion of all male Negro workers in unskilled pursuits in 1930 was much higher in the entire United States (approximately 70 per cent) than in any of the 8 cities.

The statistics presented in Tables II and III do not indicate that the principal reason so large a proportion of the Negro male workers of

the United States are in unskilled pursuits is because so large a proportion of them live in the agricultural South. The statistics do appear to indicate that the movement of Negro males to the cities, both in the North and in the South, has accelerated their movement into intellectual pursuits and into the higher manual pursuits. This is suggested by a comparison of the percentages presented in Table II for the United States with those there presented for the two groups of cities. It may be, however, that the Negro males who moved to the cities were a selected class and that this accounts, in part at least, for the larger proportion of the city workers in the higher pursuits in 1930.

On the whole, the social-economic status of Negro female workers in 1930 appears to have been considerably higher in the four Northern cities than in the four Southern cities. Were the occupational opportunities for Negro women greater in the Northern cities, or were the Negro women living in these cities more capable than those living in the Southern cities? Unfortunately, our present statistics do not fully answer these two questions. The variety of occupations pursued by Negro women in 1930 appears to have been considerably greater in the Northern than in the Southern cities, and the percentage of illiteracy in the Negro population was only about one-fifth as large in the Northern as in the Southern cities.

Doubtless, lack of the requisite education has in some measure prevented Negro workers from entering the higher manual pursuits and intellectual pursuits. The percentage of illiteracy among persons 10 years old and over in 1930 was 16.3 for Negroes, as compared with 2.7 for whites; and the percentage of persons 5 to 20 years old attending school in 1930 was 60.0 for Negroes, as compared with 71.5 for whites.<sup>12</sup> With increased educational opportunities—particularly opportunities for vocational training—and with opportunity to enter all occupations freely, a larger proportion of the Negroes will qualify for the higher occupations.

If the Negro workers are not able to advance to higher pursuits as rapidly as the machine takes over and does the unskilled work they are now doing, or if they are not able to compete with the usually better educated white workers in the higher pursuits, will they take over much of unskilled work being done by white workers?

In 1930, Negroes formed only 26.3 per cent of all unskilled workers. If, in the future, the demand for unskilled workers should decrease rapidly, it is quite probable that with this decrease many of the unskilled Negro workers who could not qualify for higher pursuits would take the places of unskilled white workers who could.

<sup>12</sup> 1930 Census, *General Report on Population*, pp. 1094 and 1219.

During the two decades from 1910 to 1930, the total number of unskilled workers in the United States decreased only from 14,251,589 to 14,008,869, or only 242,720. This fact indicates strongly that for many decades to come Negro unskilled workers (numbering only 3,683,164 in 1930 or 4,076,061, if the 392,897 croppers be included) probably will not be numerous enough to supply more than one-third of the total demand for unskilled workers. Nevertheless, many unskilled Negro workers may be without work in the future.<sup>12</sup> First, the unskilled white workers may not shift to higher pursuits rapidly enough to relinquish unskilled jobs for all the unskilled Negro workers displaced by the machine. Large numbers of white laborers may not wish to leave the farm for the city, even though qualified for higher pursuits. Second, lack of perfect mobility will result in Negro laborers not getting nearly all of the available unskilled work. For example, because of the possible renewal of the shift of cotton growing from the Old South to the newer fields of Texas and Oklahoma and because of the lack of perfect mobility of Negro workers, it seems quite possible that unemployment of unskilled Negro workers in the Old South may in future years be large and somewhat continuous. And it seems quite probable that in times of depression problems of unemployment and relief may be particularly grave among the unskilled Negro workers in our large cities.

Is there real danger that in future years there will be large numbers of unemployed Negro workers and that these and their dependents will largely comprise the permanently unemployed class certain writers have prophesied that we shall have? Indeed, may it possibly come to pass that a century after a war was fought largely to free the Negro slaves the descendants of the slave owners, along with other white persons, will be working to support on a permanent dole large numbers of the descendants of the former slaves?

While it now seems possible that in the future large numbers of the Negroes in some sections will be on relief for a time because they have been displaced in unskilled work by machines and are unable to rise to higher pursuits or do not find other unskilled work, the probabilities are that such conditions will not be general or permanent. The statistics here presented for the 20-year period 1910 to 1930 show a gradual upward trend in the social-economic status of Negro gainful workers. This trend doubtless will continue, though, as in the past, the shift to higher social-economic groups probably will be rather slow and it may be accompanied by considerable unemployment and relief.

<sup>12</sup> While the percentage of the total workers engaged in unskilled pursuits decreased from 37.3 in 1910 to 28.7 in 1930, the percentage Negroes formed of the total unskilled workers decreased from 26.6 in 1910 to 26.3 in 1930.

## THE SWEDISH CENSUS OF 1935-6\*

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THE SWEDISH Census of 1935-6 is remarkable in several respects: (1) It was motivated by the Population Commission appointed by the Riksdag in May 1935. The function of this commission was to investigate what is widely recognized as a "population crisis" and to make recommendations about future population policy. One of the Commission's first recommendations was that a special census be organized to provide a factual basis for later recommendations on matters of policy. (2) It involved a combination of an indirect census, i.e., a balance sheet drawn from the population registers, and a direct enumeration of certain data. This latter is the first attempt at a direct census ever made in Sweden. (3) It involved a combination of a complete enumeration of the population for the indirect census, and the sampling of about 20 per cent of the population for the direct census.

The aim of the Population Commission, in proposing this census, was to produce detailed and relevant data to indicate the trend in population development, and by combining demographic with social and economic factors to indicate the environmental situations which might be operating upon the people's will and capacity to marry and bear children. Since the data necessary to fulfill this aim could not be readily obtained from a single source, the census was so organized as to tap what were considered to be the most reliable sources for each class of data required. Thus the purely demographic data (date and place of birth, civil status, date of marriage and dissolution of marriage, etc.) could be obtained with the highest degree of accuracy from the population registers, where each such fact is recorded at the time it occurs. Data on income and property could be secured with the greatest reliability from the income tax authorities, where the tax declarations are checked against other sources. On the other hand, much of the data necessary for this investigation could be obtained only by direct questioning of the population. These data were mostly those relating to development rather than present status, e.g., the number of children ever born in a marriage, changes of occupation, etc., but also included a few status questions, e.g., present occupation, which was considered to be unreliably recorded in the population registers.

\* I am indebted to Dr. Ernst Höljer, Acting Chief of the Central Statistical Bureau, and to Mr. J. Sjöstrand, Supervisor of the Census, for making available the details regarding the Census and for reading this note in manuscript.

The indirect census of 1935-6 represented a complete enumeration of the population, and was directed towards two ends, (1) the determination of the age distribution by sex and civil status for each community and (2) through the identification of all the population in terms of name and residence to serve as a basis from which samples could be drawn for the direct census. The chief reasons for sampling rather than complete enumeration in the direct census were practical considerations: the necessity of getting the data as quickly and cheaply as possible and the necessity of using only qualified enumerators because of the complexity of the questions.

The indirect census was merely a simplified form of the usual decennial census and the procedure was the same as that used since 1860. This census is a balance sheet drawn from the population registers by the pastors of the Swedish State Church, who are charged with the keeping of the registers.<sup>1</sup> It indicates the legal population of each community as of December 31, 1935. A schedule was filled in for every household and included the following data for each member of the household: Name, family status (relationship to head of household), sex, occupation, physical defects (blind, deaf and dumb, imbecile, insane, epileptic), date of birth, place of birth, civil status, date of marriage, date of dissolution of marriage, whether the person was temporarily absent from the community of residence, and the address of the spouse in case of marriage separation.

After these schedules were assembled, samples were drawn from them for the direct enumeration. For the larger cities (population 20,000 or more) every fifth household was selected from the indirect schedules which were arranged in the order in which they had been filled in from the population registers, i.e., according to addresses. Lots were drawn separately for each city to indicate which household among the first five should be taken as the first household in the sample, and thereafter each fifth household was selected. Of the smaller towns and rural communities (which numbered about 2,500), one in every five communities was selected and every household investigated. The sampling of rural communities was made after the communities had first been stratified into three classes according to the occupational distribution of the population at the time of the 1930 census: agricultural communities in which at least 75 per cent of the population was occupied in or dependent upon farming, rural mixed communities in which the proportions engaged in farming were from 50 to 75 per cent, and rural industrial communities in which the proportion engaged in farming represented less than 50 per cent. Within each

<sup>1</sup> Civil registration exists only in Stockholm.

stratum of each county (Sweden is divided into 24 counties of *län*) the communities were arranged in order according to their geographical position in the county, and every fifth community in each stratum selected for the sample, lots being drawn for each group to determine which community should be the first to be drawn within the group. It was recognized that it might have been theoretically more desirable to sample one in every five households for all rural communities, but practical considerations of time and money dictated this other plan. One of the interesting by-products will be an empirical test of the validity of this sampling procedure by comparing the sample with the known universe.

After the sample for the direct enumeration had been drawn, the details obtained through the indirect census were entered on the new schedules. Thus the accuracy of the purely demographic data was insured and direct questioning on this point, except for purposes of identification, was avoided. The only exception to this rule was in regard to occupation, on which point the population registers are known to be incomplete and unreliable.

The questions on the direct schedule were organized around three main points: Economic Status and Occupational History, Children Born to Spouses Living Together at the time of the Census, and Housing Conditions.

The questions on economic status included: chief occupation, status in occupation, industry (and, in the case of employers, the number of persons employed), whether the occupation was carried on in or away from home, subsidiary occupations (in the case of married women, whether they acted as assistants to their husbands), occupation and occupational status in 1930. In addition, there were extra questions for special classes of persons: for spouses living together at the time of the census, occupation and status in occupation at the time of or shortly before marriage; for all persons over 15 years of age, education and vocational training; for all persons aged 16-66 years, occupational disability (whole or partial), whether unemployed on March 2, 1936, and total number of weeks unemployed during 1935; for all women whose present marriages were contracted after 1900 and who were living with their husbands at the time of the census, whether they gave up their jobs upon marrying, whether they migrated in connection with marriage, and the details of their occupational history since marriage.

The questions relating to the number of children ever born were limited to married spouses living together at the time of the census. Demographic details were entered for children who had died or left

home. Children of the husband and wife (in common) born before marriage were entered on the schedule as well as those born during marriage.

The questions relating to housing conditions included: the number of "real" living rooms (defined as of a minimum size, with windows or ventilation, a door that can be closed and some sort of heating); the number of "other" living rooms; the nature of the kitchen; the existence of bath room, shower room, hall, vestibule; the number of lodgers and the quarters occupied by them; the existence of a kitchen garden.

The direct census was taken in the cities from March 16 to March 31; in rural communities from March 6 to March 13, 1936. Before the enumeration began, duplicate schedules were sent out to every household included in the sample. At the same time, nation-wide propaganda was carried on, and two radio talks were held, one indicating the purpose of the census, the other explaining in detail what the separate questions meant. Thus, by the time the enumerators arrived, many of the duplicate schedules had already been completely filled in, and the enumerator's function was in these cases limited to checking up on the more difficult points.

Data on income and property for the year 1935 were entered directly on the schedules by the county tax authorities.

Taken as a whole, this census is one of the most interesting experiments in the collection of mass statistics that has ever been carried out. It was motivated by the need for information bearing on an important social problem, the questions were organized around this problem, and all available resources were used to get the desired information quickly, efficiently and reliably. The usually troublesome data on age, civil status, etc., were taken from the parish registers, the accuracy of which is unquestioned on purely demographic lines; the developmental data, relating to occupational history and the number of children ever born were obtained from the only possible source, the people themselves, and they were prepared in advance for the questions that would be asked; the housing data were checked by the observing enumerators, and the income tax data were entered from the official tax records. The combination of the direct and indirect methods of enumeration should, to some extent, act as a check on both. The combination of a sampling procedure with a complete enumeration will make possible a test of the representative nature of the sample and has a theoretical interest as well as a practical utility as a guide to the type of inference that can be drawn from the sample.

## RATES OF MENTAL DISEASE AMONG CERTAIN POPULATION GROUPS IN NEW YORK STATE

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CONSIDERABLE attention has been directed to the problem of the relative frequency of mental disease among native and foreign-born in the United States. Interest was centered, at first, upon the economic costs of mental disease, and the consequent burden imposed by the foreign element of the population. In recent years the eugenic argument has been superimposed upon the economic, and it has been set forth that immigrant populations not only have higher rates of mental disease than the native population, but that the differences are correlated with the racial compositions of the several groups.

Because of the importance of the problem, both economically and biologically, the present writer undertook a systematic analysis of the basic data, and showed that the differences in rates of mental disease between native and foreign-born whites in New York State are due primarily to variations in age composition.<sup>1,2</sup> 'Crude' rates for the two groups differ in the ratio of more than 2 to 1. Adjustment for the obvious age differences reduced the disparity, however, so that the rate of the foreign-born appeared in excess by only twenty per cent.<sup>3</sup> Another adjustment with respect to environmental factors—such as urban-rural distribution—reduced the difference in rates still further, so that the writer felt able to suggest that the remaining difference could easily be accounted for on the basis of environmental circumstances, rather than on the hypothesis of racial diversity between the two groups.<sup>3</sup> In the following note I wish to present additional data which enhance the probability of the environmental explanation.

In 1915 Dr. A. J. Rosanoff showed that during the biennial period ending June 30, 1910, native Californians had an admission rate to institutions for mental disease of 70.7 per 100,000 corresponding general population. Residents of California who had migrated from New York State had a corresponding rate of 183.8, the latter being in excess in the ratio of 2.6 to 1.<sup>4</sup> Since these were all native-born Americans,

<sup>1</sup> Benjamin Malsberg, "Mental Disease and the Melting Pot," *Journal of Nervous and Mental Disease*, Vol. 72, No. 4, October, 1930.

<sup>2</sup> Benjamin Malsberg, "Mental Disease in New York State According to Nativity and Parentage," *Mental Hygiene*, Vol. 19, No. 4, October, 1935.

<sup>3</sup> Benjamin Malsberg, "Mental Disease Among Native and Foreign-born Whites in New York State," to be published in *American Journal of Psychiatry*.

<sup>4</sup> A. J. Rosanoff, "Some Neglected Phases of Immigration," *American Journal of Insanity*, Vol. 72, July, 1915.



the racial factor was presumably constant, and Dr. Rosanoff therefore concluded that the differences in rates of mental disease must be due to the social and economic factors which are associated with migration.

It is possible to present a similar analysis for New York State on a larger scale. During the three fiscal years ending June 30, 1931, there were admitted to all institutions for mental disease in New York State a total of 15,704 native white first admissions. Of these 10,316, or 65.7 per cent, were born in New York State, and 5,388, or 34.3 per cent, were born elsewhere in the United States. The former had an average annual rate of first admissions of 44.6 per 100,000 corresponding general population. The latter had a rate of 156.9, which exceeded the former rate in the ratio of 3.5 to 1.

TABLE I  
NUMBER OF NATIVE WHITE FIRST ADMISSIONS TO ALL HOSPITALS FOR MENTAL DISEASES IN NEW YORK STATE, 1929-1931

Psychoses	Number		Average annual rate per 100,000 general population	
	Born in New York State	Born in other States	Born in New York State	Born in other States
With cerebral arteriosclerosis	1,252	705	5.4 ± 0.2	20.5 ± 0.9
General paresis	881	524	3.8 ± 0.1	15.3 ± 0.8
Alcoholic	512	327	2.2 ± 0.1	9.5 ± 0.6
Manic-depressive	1,344	797	5.8 ± 0.2	23.2 ± 0.9
Dementia praecox	2,894	1,392	12.5 ± 0.3	40.5 ± 1.3
All psychoses	10,316	5,388	44.6 ± 0.5	156.9 ± 2.4

Of the native white population resident in the State of New York on April 1, 1930, 49.9 per cent were of native parentage, and 50.1 per cent of foreign or mixed parentage. We have no separate data for those resident in New York State on April 1, 1930, who came from other states, but it is reasonable to assume that they approximate to the distribution for the entire country with respect to parentage. Of the latter group, 73.4 per cent of the native whites were of native parentage, and only 26.6 per cent of foreign or mixed parentage.<sup>5</sup> It has been shown that natives of native parentage have lower 'crude' rates of mental disease than natives of foreign or mixed parentage.<sup>6</sup> Consequently residents of New York State born in other states should have had a lower rate of first admissions than natives of New York State, other things being equal. Nevertheless, the latter had a decidedly lower 'crude' rate. The conclusion must be drawn that the dominant factor was not racial composition, but the difficulties of social and economic adjustment associated with migration.

Table I gives rates of first admissions for several of the more important groups of psychoses.

<sup>5</sup> From *Fifteenth Census of the United States, 1930*, Vol. II, page 36.  
See reference (2) above.

In connection with each group of psychoses, white residents of New York State, born in other States, had a rate greatly in excess of that of the group born in New York State. Among the psychoses with cerebral arteriosclerosis the rates were in the ratio of 3.8 to 1. In general paresis and the manic-depressive psychoses, the rates were in the ratio of 4.0 to 1. Those born in other states had a rate of first admissions with dementia praecox in excess in the ratio of 3.2 to 1. The greatest disparity occurred in connection with the alcoholic psychoses. Those born in other states had a rate in excess in the ratio of 4.3 to 1.

The rates included in Table I are 'crude' rates. Owing to the absence of census data with respect to the age composition of the two groups it is impossible to prepare standardized rates of first admissions. However it is unlikely that age is the determining factor in the production of the differences, as may be seen from the data in Table II.

TABLE II  
AGE CONSTANTS OF THE NATIVE WHITE FIRST ADMISSIONS TO ALL INSTITUTIONS  
FOR MENTAL DISEASE IN NEW YORK STATE, 1929-1931

Psychoses	Born in New York State		Born in other States	
	Average age (years)	Standard deviation (years)	Average age (years)	Standard deviation (years)
With cerebral arteriosclerosis	67.6±0.1	9.4±0.1	65.5±0.2	9.3±0.1
General paresis	43.9±0.3	11.0±0.2	43.9±0.3	10.4±0.2
Alcoholic	45.2±0.3	10.9±0.2	45.2±0.4	10.9±0.3
Manic-depressive	37.7±0.3	14.5±0.2	35.1±0.3	13.0±0.2
Dementia praecox	40.0±0.1	11.6±0.1	31.6±0.2	10.8±0.1
All psychoses	44.2±0.1	18.2±0.1	43.7±0.2	18.1±0.1

First admissions who were natives of New York State had a slightly higher average age than those born in other States, though the difference is not statistically significant. They had equivalent averages in general paresis and the alcoholic psychoses. They had higher averages with respect to psychoses with cerebral arteriosclerosis, manic-depressive psychoses and dementia praecox. Were the first admissions drawn randomly from the parent populations, it is therefore probable that the general population of native whites born in New York State was slightly older than that born in other States. This would tend to raise the rate of first admissions, since such rates increase with age. On the other hand, it is highly probable that the population born in New York State includes a higher proportion in the very young age groups (i.e., those under 15 years of age). This would tend to reduce the average rate of first admissions for the group, since rates of first admissions are lowest at the youngest age levels. However, when we balance the probable youthful proportion in the indigenous population against that in the older age groups, and consider the great excess in the average rate

of the migratory group, it does not appear likely that age differentials could account for the great disparity in rates of first admission shown above.

The rates are also influenced by the urban-rural distributions of the two groups. Urban rates of first admissions exceed rural rates. It is probable that the migrant group includes a higher proportion of urban dwellers than the indigenous population. In the absence of the essential census data, we are again unable to introduce necessary statistical corrections. However, we are able to approximate a constant distribution with respect to environment by a consideration of rates of first admissions among native-born negroes in New York State.<sup>7</sup> The negro population is concentrated very heavily in New York City, which included 79 per cent of the total negro population of the State. In comparing negroes born in New York State with those born in other parts of the United States, the difference in environmental distribution is therefore largely eliminated. The indigenous group, however, had an average annual rate of first admission of 40.0, the migratory group a rate of 186.2. The latter is in excess in the ratio of 4.7 to 1. Obviously, therefore, the differences in rates of mental disease between the indigenous and migratory populations cannot be explained as statistical artifacts, arising from differential distributions with respect to age or environment. The true rates among the migratory and native white group may be in a ratio less than that indicated by the 'crude' rates, but it is hardly likely that the difference could be eliminated by statistical adjustments.

We must conclude, therefore, that the resident white population of New York State born in that State had lower rates of first admissions than the resident population born in other States. As noted previously, the former group should have had higher rates (other things being equal), since it includes a relatively higher proportion of natives of foreign or mixed parentage. The lower rates must therefore be attributed to the generally more favorable circumstances of life surrounding the indigenous population, as contrasted with a migrating population.

<sup>7</sup> "Migration and Mental Disease Among Negroes in New York State," *American Journal of Physical Anthropology*, Vol. 21, No. 1, January, 1936.

## A BROADENED PROGRAM OF BANK REPORTS\*

BY MORTIMER J. FOX, JR.

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**W**ITHIN the past two years there have occurred three significant developments in the field of banking statistics. These have been, first, the introduction of the Federal Deposit Insurance Corporation into the field of bank supervision; second, the movement towards simplification and standardization of bank report requirements; and, third, the "statistification," for the first time, of reports of examination of banks.

The Comptroller of the Currency and the Federal Reserve Board have for many years required regular and uniform reports of condition and of earnings, expenses, and dividends from the banks under their immediate jurisdiction. Only the most fragmentary information has been available, however, for the more than 50 per cent of the nation's banks which are not affiliated with the Federal Reserve System. It has been the practice of the Comptroller of the Currency annually to assemble from State banking supervisors condensed summaries of bank condition statements which have made possible the publication of a June 30 "all banks" condition series. By abstracting the annual reports of state banking departments, the Federal Reserve Board has been able to maintain an almost comparable series as of December 31. The value of these data has been lessened by a number of factors: First, there is little uniformity among the state supervisors as to the dates of their calls. Second, there is little uniformity as to the contents of state supervisors' reports. Third, the devious methods required to assemble the data at a central point for tabulation make it impossible to publish the information much sooner than a year after the date of call. Information concerning earnings and expenses of banks not members of the Federal Reserve System has never been collected by these agencies.

Since the advent of the Federal Deposit Insurance Corporation, however, this situation has been considerably altered. Individual reports of condition are now submitted to Federal agencies upon a standard form twice each year by more than 93 per cent of the commercial banks of the country. Individual operating statements covering the annual earnings, expenses, and dividends of these same banks have also become available.

\* Revision of a paper presented at the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 30, 1936.

I have always felt that bankers would profit from a more extensive application of statistical methods to their own problems. It seems quite anomalous that the men who rely so implicitly in appraising credit risks upon such devices as the common-size condition and operating statements developed by Robert Morris Associates and others should display so little interest in developing some similar yardstick for their own institutions. In its periodical abstracts of call reports and in its Annual Report, the Federal Deposit Insurance Corporation has already published elementary devices of this type. With current condition and operating statements available for over 14,200 banks, we hope in the near future to be able to build up comprehensive data on "typical" banks, adjusted both for size of bank and for geographic factors. It is anticipated that these data will afford effective instruments of supervision, and I am sure that bankers will welcome their appearance.

With the exception of certain analyses of small, selected groups of banks, little has been done with the earnings and expense data reported by the banks of the country. Since one of the primary interests of the Federal Deposit Insurance Corporation is the successful operation of the banks whose deposits it insures, it is imperative that we be able to measure the operating efficiency of banks as it is reflected in their reports of earnings and dividends. With the cooperation of the Federal Reserve Board, the Corporation has undertaken to analyze the earnings experience of all insured state banks. Preliminary results of this analysis also were published in the Annual Report of the Corporation. The data have been related to condition figures and significant operating ratios developed for banks of various sizes. Additional ramifications of this problem are currently being explored, and it is hoped that within a short while there will have been developed a refined and comprehensive technique which will be productive of a wealth of information to students of banking.

The Federal Deposit Insurance Corporation has made every effort to lessen for its banks the task of reporting to authorities. Prior to each of our calls the Corporation has communicated with each state supervisor, offering to supply him with enough of our blanks so that his banks could satisfy both call requests by submitting duplicate copies of the one report. The response to these suggestions has been most gratifying. About 30 states are using forms supplied by the Federal Deposit Insurance Corporation or which are almost exact duplicates of the forms used by Federal agencies.

Bank condition data have been criticized as not comparing favorably with corresponding data for other industries. The ground for criticism

has been that book condition figures, which are all that have been made public in the past, bear no measurable relation to the actual *net* condition of banks.

The only reliable source of information concerning the net condition of a bank is the report of examination of that bank. Despite the obvious factors which complicate statistification of these reports—such as the varying dates of examination and the presence of the personal element in the examiner's appraisal—the Federal Deposit Insurance Corporation undertook early in 1935 to tabulate and analyze the reports of examination of the 7,500 insured banks not members of the Federal Reserve System. The results of this analysis, which is the first of its kind, were published in the Annual Report of the Corporation for 1934. So far, only the surface of this new mine of information has been tapped. We have learned, for example, the number of banks which are operating without any net sound capital, and are, therefore, technically insolvent. The analysis will make it possible to determine the current trend of the condition of bank assets. It is also possible, with these new data, to determine the relative degrees of risk attached to various types of bank investments, such as loans, investments, and other assets.

The potentialities of this new field of financial statistics seem to be unlimited. In the past, bank supervisors have had to base their policy decisions with reference to bank regulation upon their personal acquaintance with a limited number of banks. From this new information it may be possible to develop a tool which will enable supervisors to apply scientific methods to their problems of policy. The results of this type of analysis should make it possible eventually to minimize the effect of the personal element in bank examinations and to place this instrument of supervision and control upon a more objective basis. The data should prove very helpful in the development of the "typical" bank studies which I have mentioned elsewhere. Finally, and perhaps most important, the analysis of examination reports, to the extent that it reflects the true credit picture in local institutions throughout the country, should help materially in the formulation of general monetary and credit policies by the central bank authorities.

## NOTES

### THE STATISTICAL WORK OF THE NATIONAL FERTILIZER ASSOCIATION

When The National Fertilizer Association was formed in 1925 as a consolidation and successor of preceding organizations which had been functioning as active trade associations since 1883, definite provision was made in the Association's program for statistical research in the problems of the fertilizer industry and the issuance of statistical reports for the use of members of the Association and others who might have an interest in the industry's operations. The program which was formulated eleven years ago has been expanded since that time, with no important phase of the statistical work of the Association having been curtailed during the depression.

The industry statistics which had been regularly compiled for a number of years proved particularly helpful at the time of the adoption of the NRA Code and during the period of codal operation. The relatively large measure of success of such operation can be attributed in part to the fact that there was an adequate statistical basis for industry planning.

As one of its early activities the Association compiled and began the regular publication of the first comprehensive weekly, wholesale commodity price index available in this country. This index, based largely on prices as of Thursday, Friday, and Saturday, is released to the press and news ticker services on the following Monday forenoon, appears each week in *The N.F.A. News*, the official news organ of the fertilizer industry, and is reviewed each month in the *Price Index Service Letter* issued by the Association. The index contains the only series of mixed fertilizer prices which is compiled continuously, the only comprehensive weekly index of fertilizer material prices, and weekly indexes of farm product prices by groups. In addition to the all-commodity index, eleven group indexes and five subgroup indexes are compiled and released each week.

The most complete and comprehensive record available on the monthly trend of fertilizer sales is that contained in the Association's report on fertilizer tax tag sales in 17 states. Since these states account for approximately 70 per cent of the fertilizer sold in the entire country, the report indicates the trend of business in the industry as a whole. Issued about the fifth of the month for the preceding month, the report contains comparative data on monthly sales and cumulative totals for the three preceding years.

For the past ten years the Association has compiled statistics and issued a monthly report on production, shipments, and stocks on hand of superphosphate, the most important of the fertilizer materials. This has been made possible through the cooperation of a large number of producers who report their statistics to the Association.

Monthly data on exports and imports of fertilizer and fertilizer materials

are issued in a special report in order to inform members of the industry as to the volume and movement of foreign trade.

An annual report is prepared showing fertilizer consumption for the entire country and for each of the 48 states. This is the only report compiled on fertilizer consumption in the United States as a whole. These data are available from 1910 through 1935.

From time to time the results of research in fertilizer economics appear in the *Price Index Service Letter*, *The N.F.A. News*, and *The Fertilizer Review*. Constant study is given to trends in farm income and prices and their effect on fertilizer sales.

The statistical work is carried on under the supervision of Herbert Willett, statistician and economist of the Association.

CHARLES J. BRAND

*Executive Secretary and Treasurer*

## STATISTICAL PROBABILITY

In recent discussions on probability theory—as, for example, in Professor Nagel's paper in this JOURNAL<sup>1</sup>—the increasing acceptance of frequency as the experimental basis of probability will be regarded with satisfaction by almost all statisticians and physicists. It is impossible, as Dr. Margenau pointed out in his remarks following that paper, to restrict the use of the word "probability" to its technical sense; but we should always be ready to recognize when people are, and when they are not, doing so.

It was to stress the distinction between scientific and non-scientific probabilities that some time ago<sup>2</sup> I stressed that only the former should rightly be referred to as "chances," in the sense that, in contrast to the subjective nature of "degrees of belief," they refer to a supposed external system of causes which are giving rise to our observed frequencies. If it is accepted that our scientific use of probability is to refer only to statistical probability or chance, the remaining problem seems to lie in providing a logical relationship between probability and frequency.

For the pure mathematician there is no difficulty. The validity of the axioms on which probability theory rests do not concern him. From the laws of probability he deduces "expected" frequency averages and fluctuations, in particular showing (with a somewhat extended notion of his usual idea of a limit) that the limit of the theoretical relative frequency is the value of the probability. It is the relationship of this mathematical theory to *actual* frequencies which is of concern to scientists, and which needs to be made clear. Briefly, I would explain it as follows: that from observed frequencies we *infer* probabilities, or in other words, that probability is a *theory* of observed frequency.

From this point of view, probability is similar to other useful scientific concepts. If it is asked: "Is it correct to define probability in terms of fre-

<sup>1</sup> 31 (1936), 10-26.

<sup>2</sup> *Proc. Roy. Soc. A.* 141 (1933), 518-534.



quency?" I would first of all make sure what exactly is meant by a definition. If we recognize that in modern science a definition does not pretend to tell us what something is, but only how we are to set about measuring it, then I would agree that the frequency definition is legitimate. At the same time, we should realise that this definition is based on the laws of probability; this should not be regarded as a drawback, for until we have a probability theory, it is meaningless to talk about a probability in any scientific sense.

This attitude, which is as far as I am aware the accepted one for physical concepts, such as mass and temperature, seems to dispose of criticisms levelled at the frequency approach. It was suggested by Dr. Margenau that the frequency definition be supplemented by the statement that the limit should be insensitive to rearrangement of the ordered sequence by a pre-assigned rule, in order to avoid such phenomena as regularly alternate heads and tails in coin-tossing being ascribed to chance. From the point of view adopted here, however, this is not necessary, for we are not asserting that we can always say when a probability exists, but merely, if we assume it to exist, how we should attempt to measure it. (Our definition supposes of course that the order of the original sequence is preserved, analogously to the limit of a conditionally convergent series.) Such properties as the invariance of the limit to "blind" selection are, however, useful to us when we are trying to decide whether the observed occurrence of an event appears sufficiently random to be compatible with the probability idea.

To many people this approach may seem too empirical, but it is not more so than is logically necessary. Any theory can only be upheld or discarded in the light of experience; and moreover, as experience accumulates, the extent to which the theory is applicable in different problems becomes known. The question whether the statistical probability or chance can be said to exist, or is always merely a convenient approximation or assumption, is irrelevant for its practical use, though it may afford some interesting speculation. Here I would agree with a remark by Jeffreys<sup>\*</sup> that the notion of chance may never be exactly realised in practice. This he amplifies later as follows:

In the throw of an unbiased dice, for instance, the probability of a 6 is one-sixth on the supposition that the laws of dynamics hold, and that the probability of the rotation during flight is uniformly distributed over a wide range. The latter assumption is an approximation. In the kinetic theory of gases the estimated time needed to establish an approximately Maxwellian distribution depends on the supposition that the molecules do not begin in such paths that the relative velocities at the first collision are in the line of centres; small deviations in the direction of the initial velocities are required to make the theory-work, and the postulate is that within these ranges the probability of the directions is uniformly distributed. This is an approximation of the same character as for dice. The same may be true of the probabilities in wave mechanics.

Similarly in the genetical phenomena of linkage and crossing-over, it is unlikely, apart from well-known sex differences, that the assumption of an

<sup>\*</sup> *Proc. Roy. Soc. A* 146 (1934), 9-16.

exact value for the chance of crossing-over, given a constant external environment, is valid—this chance of crossing-over will depend to a slight extent on the particular complex of genes the chromosomes are carrying. Nevertheless, the assumption is sufficiently accurate for inferences to be made from experimental observations that this “chance” is sometimes appreciably affected by change of external conditions such as rise in temperature.

The practical value of probability will depend in any instance on the value of the approximation or assumption made. All statisticians are aware of a continuous passage from situations in which probability appears to hold exactly, such as in radio-active disintegration in physics, or in biological experimentation where it has been *made to hold* by appropriate randomization, to those where the value of using probability becomes highly questionable, as, for example, with certain types of economic time-series.

In one sense all our statistical probabilities can be regarded simply as mathematical fictions; but that should hardly be accepted as a criticism, for if it were, few, if any, of the familiar concepts of science would be left to us. Our probabilities may be said to exist objectively in the usual and necessary sense—that they are theoretically measurable, and sufficiently well substantiated by experiment.

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## NOTE ON AN INDEX OF BOND PRICES

Three methods currently used to construct an index of bond prices might be described briefly as follows:

Method I. An index of bond prices derived by taking the arithmetic average of the prices of a selected group of bonds. For example, this method is used by *The Annalist*, the New York Stock Exchange, and *The Financial Post*, Canada.

Method II. An index of bond prices derived by taking a typical standard bond of fixed coupon rate and fixed term to maturity, and finding the price of this standard bond which would correspond to the average yield of the bonds used. Standard Statistics<sup>1</sup> and Moody's Investment Service<sup>2</sup> use this method.

Method III. An index of bond prices derived by capitalizing a selected fixed annual income at the rate of interest given by the average yield of the bonds utilized. This type of index is used by Persons in *Forecasting Business Cycles*,<sup>3</sup> Dow, Jones, and Co.,<sup>4</sup> and the Dominion Bureau of Statistics, Canada.<sup>5</sup>

<sup>1</sup> e.g., *Annual Supplement Survey of Current Business*, U.S. Dept. Com., 1932, p. 291.

<sup>2</sup> e.g., in *Commercial and Financial Chronicle*.

<sup>3</sup> e.g., pp. 93-107, 113-127, 134-143, 157-167; column 8.

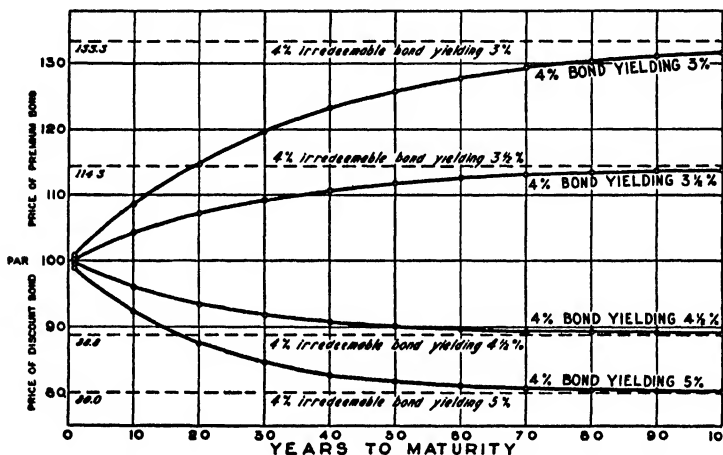
<sup>4</sup> e.g., *Annual Supplement Survey of Current Business*, *Ibid*.

<sup>5</sup> e.g., *Monthly Review of Business Statistics*, Jan., 1936, p. 15; Oct., 1935, pp. 6, 10, 30.

In this note we wish to draw attention to the precise meaning and consequent limitation of a bond price index which is obtained by method III, which, for brevity we might term the "capitalization method."

The construction of a series of index numbers for the average prices of a selected group of bonds by the capitalization method might be described as follows: The base figure 100 is the capitalized value (= 100) of an income of \$4.00<sup>6</sup> per annum at a rate of 4 per cent. The index number for the average price of these bonds at any date is then obtained by capitalizing the same income of \$4.00 at the rate of the average yield of the bonds for that date;<sup>7</sup>

CHART I



symbolically,  $I = 4.00/i$ ,  $I$  being the index number corresponding to yield rate  $i$ . Thus, each index number is nothing more nor less than the price of an irredeemable 4 per cent bond bought at a yield rate equal to the average yield of the bonds utilized, for the average of the yields to maturity of the several bonds is treated merely as current yield.<sup>8</sup>

Although this index is mathematically correct only for irredeemable or perpetual bonds such as British Consols, French *rentes*, et cetera, it does serve as a sufficiently approximate measure of the trend in bond prices for bonds whose maturity dates are so far distant that the influence of redemption upon their prices is negligible. For example, the ten railroad bonds used by Persons have on the average fifty or more years to run, and this type of index applied to them furnishes a close approximation to the trend in the actual average prices of these bonds.

Without attempting here to describe the intricate details of bond price computations,<sup>9</sup> it may be readily verified that, for any given yield, the longer

<sup>6</sup> Any other fixed amount could be used.

<sup>7</sup> Persons (*ibid.*, p. 90, or *Review of Economic Statistics*, vol. VIII, no. 1, p. 41) expresses this as capitalizing the yields at 4 per cent, but this is not in accord with the accepted mathematical definition of capitalization; e.g., see E. B. Skinner, *Mathematical Theory of Investment*, p. 283.

<sup>8</sup> See Moore, J. H., *Handbook of Financial Mathematics*, p. 487.

<sup>9</sup> *Ibid.*, pp. 376-577.

the term a bond has to run, the more closely does its price approximate to that of an irredeemable bond having the same coupon rate and the same yield; or, what is the same thing, the shorter the term a bond has to run, the further does its price recede from that of the corresponding irredeemable bond. In view of this relationship, we could scarcely expect this index to give sufficiently close approximations to the actual price movement of short and medium term bonds, and, for such bonds, indices computed by methods I or II would be better.

Some idea of the extent to which this capitalization method is inadequate can be gathered from the accompanying chart which serves to show how the price of a 4 per cent bond bought at the given yields of 5 per cent,  $4\frac{1}{2}$  per cent,  $3\frac{1}{2}$  per cent, and 3 per cent changes with the term to maturity. The influence of maturity alone upon the price is of comparatively little consequence when the bond is far removed from the maturity date. Thus, at a yield of 5 per cent, the price rise between the 60- and 50-year terms to run is about \$0.66 (from approximately 81.03 to 81.69), while the rise between the 30- to 20-year terms to run is about \$2.90 (approximately 84.55 to 87.45). Technically expressed, the price curve for any given yield does not slope uniformly, tending rather to converge more slowly with increasing maturity—the price of the corresponding irredeemable bond being the asymptotic limit (an upper limit in the case of a premium bond, a lower limit for the discount bond).

As a concrete illustration of the inapplicability of this index to bonds which are not very long term bonds, we cite the following results for a group of six Dominion Canada Government bonds of various maturities. The approximate asked prices and yields for these bonds on two given dates are:<sup>10</sup>

Rate	Due	Dec. 2, 1933		Dec. 1, 1934	
		Price	Yield	Price	Yield
$4\frac{1}{2}$	1949-59	99.50	4.60	109.25	3.69
$4\frac{1}{2}$	1948-58	98.65	4.60	109.15	3.66
4	1947-52	94.50	4.43	104.65	3.55
$4\frac{1}{2}$	1946	100.00	4.50	109.15	3.51
$4\frac{1}{2}$	1944	100.00	4.50	109.15	3.40
5	1943	102.75	4.65	112.50	3.36
Average		99.23	4.55	108.98	3.53

The index numbers for the average prices on Dec. 2, 1933, and Dec. 1, 1934, from the formula<sup>11</sup> are 87.9 and 113.3 respectively. Clearly, these figures are an extremely inaccurate representation of the actual change in the average price of this group of bonds, since they indicate a price change from 1933 to 1934 of about 28.9 per cent, while the approximate actual change was only about 9.8 per cent.

It appears to be obvious that this index cannot be regarded as a sensible

<sup>10</sup> Data from A. E. Ames and Co.

<sup>11</sup> Fixed amount capitalised assumed to be \$4.00.

indicator of the actual price changes for short or medium term bonds, and should not be used for bonds of this class. When the bonds utilized have very distant maturities, however, the index does give a close approximation to the actual prices, and may be regarded as a reliable index of the bond price trend for such bonds.

So far as the writer is aware, no mention of this maturity requirement is made by Persons or other references consulted, and, consequently, the index may be credited with more general application as a bond price index than it merits.

In conclusion, we might remark upon the advisability of using the trend in bond yields as a more significant indicator of comparable bond value in many cases. The Babsonchart of Business Conditions, for instance, traces the variations in the average yield of 60 active bonds. These yields are plotted on an inverted scale, giving the yield trend an apparent direction similar to that of the price trend. *The Annalist* plots the average yields of ten railroad bonds in this same way, showing the yield trend on the same chart as the bond price trend (computed by method I) for these bonds. Briefly, indices of bond yields would seem to present a very useful measure of bond value comparisons for many purposes.

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## PROGRESS OF WORK IN THE CENSUS BUREAU

The 74th Congress adjourned without having made any provision for a compilation of accident statistics, such as that which was described in the December issue of the JOURNAL. Neither did it pass the Joint Resolution, introduced about 5 days before the adjournment, providing for a census of employment and population to be taken some time within the next ten months under the provisions of the Act of 1929 providing for the Fifteenth and subsequent decennial censuses.

## THE PRINTING SITUATION

The Bureau of the Census in recent years has experienced great difficulty in obtaining sufficient funds to provide for printing its reports. As a result reports have been delayed and to some extent curtailed; the editions have been reduced; and it has happened more than once that completed reports have to be carried over to be printed out of the allotment for the next year. Because of such a carry-over from the preceding year the printing allotment of \$82,000 for the fiscal year 1935-36 was exhausted early in January, which meant that a number of important reports would have to wait until the 1st of July 1936 before they could be forwarded for printing. Among these were the 1934 reports on Mortality, Births, Financial Statistics of Cities, Prisoners, and Mental Patients. This situation was brought forcibly to the attention of the House Committee on Appropriations by a memorandum prepared in the Census Bureau and submitted at the hearings last

February. The Committee in response to this appeal set apart from the general appropriation the sum of \$35,000 to be immediately available for printing the delayed reports. This sum did not, of course, actually become available until the Appropriation Act was passed on May 15th. The reports are now being prepared for offset printing, as the sum was not sufficient to cover the cost of printing from type.

The printed record of the hearings before the Committee include the memorandum submitted by the Bureau and also the resolutions relative to Census printing adopted by the Census Advisory Committee at its meeting last November; and in its report the House Committee went on record in favor of the principle for which the Bureau has always contended, namely that provisions for printing the results of any census or statistical inquiry should be included with the appropriation for collecting and tabulating the data, instead of depending upon an allotment from a general printing appropriation made for a later year after the tabulations have been completed.

#### LIFE TABLES

The Bureau has for some time had in preparation a set of life tables making use of the results of the census of 1930. Tables for white males, white females, Negro males, and Negro females, based on population in 1930 and deaths from 1929 to 1931, were published in a recent issue of *Special Reports—Vital Statistics*. These and the other tables that have been prepared will be included in the volume which is to be issued later.

This is the first time that it has been possible to prepare life tables covering all continental United States. The Glover Tables, which were prepared in the Census Bureau in the period following the census of 1910, were necessarily limited to the original registration states. After the census of 1920 abridged life tables were prepared covering the registration states of 1920.

In order to compare conditions at the present time with those of an earlier period one needs to have tables covering the same territory. To meet that need the Bureau is preparing three sets of tables covering the registration states of 1920, one set based on population in 1930 and deaths 1929 to 1931, another on population in 1920 and 1930 and deaths 1921 to 1929, and a third on population in 1920 and deaths 1919 to 1921. These will be complete tables giving data by single years of age for whites and Negroes of each sex. Heretofore the only life tables available for 1920 have been the abridged tables mentioned above. Then there will be tables covering the original registration states but based on the population in 1930 and deaths 1929 to 1931. These tables will make it possible to study the changes that took place in the expectation of life and in other life table functions during the period 1900 to 1930.

#### CENSUS OF BUSINESS

The field canvass for the 1935 census of business is completed. The first series of retail tables have been published for certain states giving number of stores, sales, employment and pay roll by kinds of business. These tables

will be followed by detailed state reports showing by counties, cities, and towns the full range of statistical data similar to the state reports for previous censuses. They will include commodity sales tables, such as were shown in the 1929 census of distribution but were omitted in 1933. Wholesale reports will be ready for some States in October.

Because of the variety of subjects covered, the Bureau has provided a two-page check list containing brief descriptions of each series of reports, on which those persons requesting publications are asked to indicate exactly what reports are wanted and for what States or cities. Copies of the check list may be had on application to the Bureau of the Census at Washington or at Philadelphia, and are returnable to the Philadelphia office from which all publications will be distributed.

J. A. H.

### GRAPHIC PRESENTATION

Some of our readers will recall that back in 1914 the American Statistical Association joined with sixteen other interested organizations to form a joint committee on Standards for Graphic Presentation. In fact, our representative, Mr. L. P. Ayres, became secretary of the committee. The following year this joint committee published a report which defined certain terms employed in graphical presentation and set up certain standards of practice for the construction of graphs and charts.<sup>1</sup> This report is still valuable as a guide.

In 1926 at the request of The American Society of Mechanical Engineers the American Standards Association authorized the organization of a national technical committee to make an intensive study of this subject in its various aspects and to prepare a series of standard practices which will eventually become American Standards. This Sectional Committee on Standards for Graphic Presentation was organized in November 1926 and is now headed by Mr. Willard Chevalier, Vice-President, McGraw-Hill Publishing Company, as chairman. Shortly after its organization it formed subcommittees on "Time Series Charts" and "Engineering and Scientific Graphs." Mr. A. H. Richardson has served as chairman of the first and Dr. W. A. Shewhart has served as chairman of the second. This sectional committee now consists of official representatives of 25 national organizations of which the American Statistical Association is one, with the A.S.M.E. as the sponsor body.

The Subcommittee on Time Series Charts completed the first tentative draft of its report last April. This is now available in pamphlet form.<sup>2</sup> In its present form this code has been limited almost entirely to line charts but column and surface forms of time series charts are discussed in the appendix. As good graphic presentation does not depend on a single broad decision but on a considerable number of detailed decisions, the code is necessarily

<sup>1</sup> This JOURNAL vol. 14, 1915, pp. 790-8.

<sup>2</sup> Copies may be secured from the Publication-Sales Department, ASME, 29 West 39th Street, New York, N. Y., Price \$1.00.

made up of a rather detailed discussion of specific points. Some of these may not in themselves seem important, but collectively, it is the decisions on such minor points which determine the success or failure of a chart.

The committee has worked on the principle that flexibility rather than standardization must be the keynote in any successful code of preferred practice. The chart must be prepared in the light of the characteristics of the data at hand, and the use to which the chart is to be put, but such individual treatment, to be effective, must not do violence to the fundamental principles of graphic presentation.

The Subcommittee on Engineering and Scientific Graphs completed and published in November 1932 what was in effect a tentative draft of its more complete report. This covered the construction of graphs with special reference to their use as lantern slides. The subcommittee has kept, however, steadily at work on its complete report through the activities of a subgroup, Mr. H. F. Dodge, chairman, and expects to make it available in tentative draft form early in the fall. This proposed American Standard which will cover recommended practices for the presentation in a plane of the functional relationship between two variables is intended for the guidance of authors, editors, and draftsmen who are preparing graphs for reproduction in scientific and technical publications.

## LETTERS TO THE EDITORS

Mr. F. E. Andrews, author of *New Numbers*, which was reviewed in the June, 1936, issue of this JOURNAL, makes the following comment, in a letter to the Review Editor, on Mr. Lovitt's review:

In one paragraph of his review Mr. Lovitt charges that "the book is crowded with bald assertions for which no proof is attempted. For example, p. 49: 'An examination of 6 reveals real possibilities. It is at least far better than our present number base.'" Now page 49 does include the assertion Mr. Lovitt quotes, and immediately following it are given three reasons for the superiority of 6 as a number base, and one limitation against it. In brief, the reviewer truncates the supporting evidence from his quotation, and then condemns the book for the alleged absence of the material *he* has cut out.

In another paragraph Mr. Lovitt challenges the accuracy of the book. Now I should be amazed if a book with as many computations as this one failed to include some errors. But many mathematicians have now been over it, and no error has yet been called to my attention. The two Mr. Lovitt finds happen to be due to his own inability to add.

The question is the number of products ending in zero in the complete multiplication tables of the two number systems. "Complete multiplication table" is further defined as "multiplying the first twelve quantities by each of the first twelve quantities."

Here is a simple question of fact which, at least for the ten base, a sixth-grade schoolboy could solve. Twelve products ending in zero are found in the 10-line table; six in the 5-line table; two each in the 2, 4, 6, 8, and 12-line tables; one each in the 1, 3, 7, 9, and 11-line tables. Total, 33. Mr. Lovitt thinks there are only 32. He concludes it must be the book which is inaccurate.

Mr. Lovitt has submitted the following reply:



Mr. Andrews is correct in his statement on p. 58 that "in the system of 10, 33 of the totals end in zero."

In a letter to the Editor of the JOURNAL protesting Professor David McCahan's review of *Insurance and Annuities from the Buyer's Point of View*, in the March, 1936, issue of this JOURNAL, Mr. E. C. Harwood, one of the authors of the volume, makes the following comment:

There are a number of inaccuracies in the review which I will not touch upon . . . . It does seem advisable, however, to point out that Mr. McCahan has either greatly exaggerated, or that he has important information not available to the general public. He asserts that our ratings of the companies and cost comparisons are " . . . dangerously misleading to the reader who acts on them." I feel that this is a matter of grave importance, and that Mr. McCahan should have boldly indicated which of the rated policies would prove "dangerous" to the reader who selects them.

Professor McCahan in his reply says:

Mr. Harwood is very evidently begging the entire question . . . . I did not say that any of the "rated policies" would prove dangerous, but rather that his method of rating them and that his suggestion of dropping the insurance in one company and taking it out in another on the basis of a superficial, and wholly unscientific rating plan, may be "dangerously misleading to the reader who acts on them."

#### A CORRECTION

In the paper by Samuel A. Stouffer, this JOURNAL, vol. 31, (June, 1936), p. 352, the sentence containing equation (3d) should be corrected to read: "As a consequence of the operation in passing from (3b) to (3c), any ( $s-1$ )-rowed minor of  $\Delta$ ,

$$\Delta_{ij} = \frac{\sqrt{d_{ii}d_{jj}}}{d_{11}d_{22} \cdots d_{ss}} \Delta'_{ij},"$$

## CHAPTER ACTIVITIES

**THE ALBANY CHAPTER.**—The annual meeting of the Albany Chapter was held May 18, 1936, at the Candle Light Inn in Albany. Dr. Warren W. Coxe, President of the Chapter, presided. The Secretary reported that there had been five meetings and one picnic during the preceding year with an aggregate attendance of 145 members and guests. He also reported that there were 39 members in the Chapter and that there was a comfortable balance in the treasury. The following officers were elected for the ensuing year: Dr. Warren W. Coxe, Director of Research, State Education Department, President; Miss Elizabeth Parkhurst, Senior Statistician, State Department of Health, Vice-President; Dr. R. F. Bucknam, Associate Rates Examiner, Public Service Commission of New York, Secretary-Treasurer; and Messrs. C. M. Armstrong, General Electric Company, and E. H. Van Winkle, Professor of Business Statistics, Rensselaer Polytechnic Institute, members of the Executive Committee.

Dr. Joseph S. Davis, President of the American Statistical Association, spoke on "The Art of Statistical Exposition." He explained that he wished to include not merely the presentation of statistical data in tables and charts, but all of the phases involved in setting forth, in written or oral form, analyses and interpretations involving statistical data. He explained further that he wished to speak not as a master of this art but as one who has been struggling for years to learn how to speak and write clearly, interestingly, and effectively, with special reference to subjects that involve statistical materials.

Statistics may be regarded as an addition to the language which may be used cleverly or clumsily, carelessly or skilfully. The art of using statistics interestingly and effectively has been unduly neglected, and is worthy of study and cultivation. Masters of this art are few, and the general level of our current performance is far below reasonably attainable standards.

In some quarters there has been for many years an urge to set up standards for statistical presentation—in particular, rules for graphic representation and table construction. Some of those developed are good, some are bad; but generally they have the vice of tending to be restrictive, strait-jacketing. Another line of attack might be favored. It involves, first, the enunciation of significant broad principles that can be applied with flexibility and individual variations in almost all situations; and, second, the collection of a large number of examples to illustrate good, bad, and indifferent modes of application.

Since very little attention has been focussed on *principles*, Dr. Davis presented a number of them briefly. As basic principles he suggested the following: *Consider your readers (or hearers)*. Unless one has clearly in mind the group for whom he is preparing tables, charts, and statistical discussions, he cannot safely expect them to understand and like what he presents. What is appropriate in a paper to be read in print is often inappropriate in an oral

address; in the latter, greater simplicity in almost every detail is usually essential. *Be earnestly considerate of your readers (or hearers).* Deal with them in such a way as not to overstrain their capacities or needlessly wound their sensibilities. *Let the purpose of the presentation dominate the details of its exposition.* Many questions can be settled better by considering the purpose of the presentation and the convenience of the reader than by any uniform rule. The discussion was developed further in terms of eight subsidiary and related principles expressed in more specific terms.

General discussion on the subject followed the talk by Dr. Davis and at the conclusion of this discussion he was given a rising vote of thanks. There was then an informal discussion about programs for the ensuing year. It was generally agreed that some of the subjects should be of a technical character and others of a more general interest. Dr. Davis was asked for his advice. He brought out that the Statistical Association is not and never has been exclusively an association of statisticians. Membership is open to those seriously interested in statistics. He suggested that the character of chapter programs had more bearing on the make-up of the group who attended than on the number in attendance. He described the experience of the San Francisco Chapter, in which almost none of the meetings are concerned with mathematical statistics, and several programs fall outside the statistical field. He expressed the opinion that meetings for discussion of topics with significant statistical aspects drew about as large attendance as meetings having no particular relation to statistics.

**THE AUSTIN CHAPTER.**—The Austin Chapter held its third meeting of the year on April 30, 1936, in the Union Building on the campus of The University of Texas. The principal speaker was Dr. John R. Stockton, formerly Chief of the Bureau of Marketing Research of the Meredith Publishing Company, now Assistant Professor of Business Administration at The University of Texas. Dr. Stockton spoke on the "Use of Statistics by a Magazine Publisher." Twenty-nine members and guests were present at the meeting. A number engaged in round table discussion of the paper at the conclusion of Dr. Stockton's address. Officers for the ensuing year were re-elected as follows: Dr. F. A. Buechel, Director of the Bureau of Business Research, University of Texas, President; Mr. F. E. Finely of the United States Bureau of Agricultural Economics, Vice-President; and Mr. C. D. Simmons, Professor of Business Statistics and Investment Officer of The University of Texas, Secretary.

**THE CHICAGO CHAPTER.**—The annual meeting of the Chapter was held on May 6, 1936, bringing to a close a most successful year. During the past year, the Chapter held six dinner meetings, with an average attendance of 55, and had a membership of 107 as against 73 the previous year. Officers elected for the coming year are as follows: President, Harland H. Allen, Editor of the Harland Allen Economic Letters; Vice-President, John H. Noble of Armour & Co.; and Directors, John W. Boatwright, Statistician,

Standard Oil Company of Indiana; H. B. Stair, Statistician, Illinois Bell Telephone Co.; and Theodore O. Yntema, Professor of Statistics, University of Chicago.

Following the business meeting, the Chapter heard two very interesting addresses. The first speaker was Harris G. Pett, Manager, Division of Research and Statistics, Federal Reserve Bank of Chicago, who spoke on "Keeping Up With Business Conditions." He was followed by Roderick P. Stewart, Chief editorial representative of the *Wall Street Journal* in Chicago, who discussed "Keeping Up With the Corporations."

**THE CLEVELAND CHAPTER.**—The fifth meeting of the Business Statistics Section of the Cleveland Chapter was held on Monday, March 16. The group made its semi-annual forecast of the Federal Reserve index of industrial production. The arithmetic mean of the individual forecasts for the 12 months ending with January, 1937, was 12 per cent above the actual for the 12 months ending with January, 1936. The percentage improvement estimated by the individual members ranged from 7 per cent to 18 per cent. The next meeting of the Business Statistics Section will take place in September.

The annual meeting of the Cleveland Chapter was held on Monday evening, May 11, in the Cleveland Chamber of Commerce Club. Theodore H. Smith, Professor of Marketing at Fenn College, made an informative and interesting address on the subject of "Consumer Cooperatives." Col. Leonard P. Ayres, Vice-President of The Cleveland Trust Company, spoke on "Inflation and Its Timing." Col. Ayres summarized the contents of the most recent pamphlet issued by The Cleveland Trust Company, "Inflation." Mr. L. M. Whittington of the Van Sweringen Company was chosen as President of the Chapter for the ensuing year and Dr. Frank T. Carlton of Case School of Applied Science, as Vice-President.

**THE CONNECTICUT CHAPTER.**—The Regular and Business Sections of the Connecticut Chapter met on April 23, 1936, for an open forum discussion of "The Present Business Trend, Will It Continue?" and "The Effect of Continued Unemployment and Heavy Federal Expenditures." On May 26, Dr. F. K. Shuttleworth of the Yale Institute of Human Relations spoke on "Sexual Maturation and Growth of Girls." The Chapter discussed plans for the next academic year, particularly on the possible inclusion of subjects dealing with vital statistics and demography in general and with respect to the choice of business and economic subjects for coming meetings.

**THE NEW YORK DISTRICT CHAPTER.**—At a dinner meeting of the New York District Chapter of the American Statistical Association held on May 21, 1936, the general topic was "The Future of Interest Rates." The presiding officer was Mr. F. R. Macaulay of Bernstein-Macaulay.

The first speaker, Colonel Allen M. Pope, spoke on the subject, "The Bond Market as Affected by the Trend in Interest Rates." He believed that the change in our present low yield on Government investments can

come from five general causes, namely: (1) increased use of funds for capital improvements, (2) increased use of funds for current needs of industry, (3) investment of capital abroad or flights of capital abroad, (4) waste or destruction of capital, such as the result of a war, and (5) artificial tampering with natural economic laws. The first three causes do not seem likely to produce any significant effects very soon. Little tightening of money rates in this country would be produced by a European war in which we were strictly neutral. Changes in money rates because of artificial tampering with natural economic laws are by far the most likely. Attention was called specifically to the probable results from the Social Security Act, possible changes in Reserve requirements, sale of Government securities held by the Reserve System, and the continued increase in Government debt. Mr. Pope's conclusions were that in the near future the danger of a change in the trend of money rates upward comes, if at all, from the acts of our own Government, which already has it in its power to produce such changes. For a long time the buying power for new Government securities can be maintained, but a point may be reached when it is too dangerous to go further in increasing our debt, namely, when the resulting excessive taxation will actually diminish the aggregate wealth of the country.

Mr. L. R. Robinson spoke on the subject, "Interest Rates and Commodity Prices." Whether price changes are analyzed from the standpoint of the business cycle or from the standpoint of purely monetary or credit factors, a close relationship is found between the movements of commodity prices and the movements of long-term, high-grade bond yields, and this logical relationship stands out over the longer term in the recorded trends. In only one of the last five years, however, have bond yields and prices moved together. During the next two or three years, Mr. Robinson expects a considerable rise in the level of prices, with an increase in interest rates generally. In comment on Mr. Robinson's paper, the presiding officer questioned the closeness of the parallelism between British Consols and commodity prices. He called attention to the desirability of considering associated circumstances, such as the changes in the physical volume of business, the fears that the rise will get out of hand, and the like.

Professor B. H. Beckhart of Columbia University spoke on "The Future of Interest Rates and the Money Market." While admitting that in the long run, short-term rates of interest will rise because they obviously cannot decline further, he discussed the question of how long these rates will remain at these present levels and when a rise may be expected. He emphasized the peculiar relation of the U. S. Treasury Department to the money market. The Treasury desires to continue to float its obligations at the lowest possible rate of interest and in some respects has usurped the central banking functions of the Federal Reserve Banks as one of the consequences flowing from the devaluation of the gold dollar and from silver purchases. Through Treasury control therefore, short-term rates will continue at low levels for several years. There are, to be sure, various factors which might tend toward a reduction in excess reserves, namely: (1) gold exports, (2) an increase in

currency, (3) increases in deposit totals, (4) administrative action, such as reclassification of cities as Reserve and Central Reserve cities, and (5) reduction of the security portfolio of the Federal Reserve Banks. Factors which might tend toward an increase in Member Bank reserves include further, gold imports, use of profits of gold devaluation, and silver purchases and revaluation. Weighing these factors, the chances are that excess reserves may actually be increased during the next two or three years. Low money rates will continue until excess reserves are eliminated or absorbed or until a sharp increase in commodity prices occurs. From a broad economic point of view, the low money market rates of interest now prevailing are highly dangerous in that they will stimulate a rapid expansion in private debt and the production of capital goods and that the income from capital goods will be capitalized at artificially low rates. The next crisis will probably be characterized, therefore, by a drastic readjustment in capital values resulting from the ultimately inevitable rise in interest rates.

The last scheduled speaker was Dr. Lionel D. Edie on the subject, "Long-Term Interest Rates." Dr. Edie emphasized the change in the financial point of view, as a result of which banks are not only buying longer term Governments but are enthusiastic about it. He believed that the only place where we now have a wild inflation is in the high grade bond market, which is inflated relatively more than the stock market was in 1929 and is just as vulnerable. It was his guess that the low for money rates and the peak of bond prices will prove to be the middle of 1936 plus or minus twelve months. He believes that other speakers have exaggerated the influence of excess reserves on the outlook for bond prices and also have put too much stress upon the ability of the Government to dominate bond prices and the level of money rates. He stressed, on the other hand, the growth of normal demand for capital growing out of the restoration of confidence and business recovery.

In discussion, the presiding officer expressed the opinion that we will not have any of that type of violent currency inflation that leads to panicky fear and that, under certain circumstances, we are likely to enter one of the greatest booms this country has ever seen affecting commodity prices, business, building, and the stock market. The result would, of course, be at least some reduction in bond prices. Dr. W. R. Burgess, of the New York Federal Reserve Bank, pointed out that Mr. Robinson and Mr. Edie had approached the problem through the analysis of the trends and the swings of the cycle, while Colonel Pope and Professor Beckhart had made use of a sort of accounting analysis of the money position. If you approach the problem from the latter point of view, the outstanding feature is the uniqueness of the whole present situation. Mr. J. F. Hughes expressed the view that in spite of the tremendous demand for new capital, the philosophy of the new era of high stock prices was not disturbed until the Federal Reserve Board decided they had run too far. It would seem possible to have a moderate increase of capital demand, yet for a number of years have a new era of high bond prices along with it.

**THE PHILADELPHIA CHAPTER.**—The Philadelphia Chapter of the American Statistical Association discussed "Building and Business Revival" at a dinner meeting on April 24, 1936.

Mr. David T. Rowlands of the Wharton School of the University of Pennsylvania discussed the general question of the building industry and business activity. He pointed out that the volume of building fluctuates much more widely than building costs, and indicated that building volume is not closely related to building costs. The current situation in building was analyzed and the significance of fluctuations in the volume of building activity to investors in real estate was noted.

Mr. Ernest M. Fisher, Director of the Division of Economics and Statistics of the Federal Housing Administration, analyzed problems in measuring the demand for building. Emphasis was placed upon the very great difficulty in defining the units of measurement and in securing adequate data as to the supply of building of various types. The real property inventory of 64 cities has been extended to cover more than 150 cities. It forms an important beginning of an adequate statistical basis for measuring demand. Further, in regard to residential properties, the difficulty of defining a dwelling unit, of defining, for residential purposes, a family and the difficulty of setting up minimum standards of housing that are universally applicable was stressed. The problem is further complicated by the extraordinary mobility of the population. The building industry is relatively inflexible in comparison with the fluctuations in demand. There are some 30,000,000 dwelling units in the United States and the maximum annual production is 800,000. Thus with such a small increment of change possible the fluctuation of 5 per cent up or down in demand creates a very great dislocation in the entire residential construction field. In the industrial field, measurement of demand is complicated by the migration of industries between different parts of the country and even within the same metropolitan area; also by the rate of obsolescence of industrial equipment regarding which further information is needed. In the commercial field, prosperity brings a large amount of building of monumental structures connected with the desire to perpetuate an individual or corporate name.

Mr. David L. Wickens of the National Bureau of Economic Research discussed real estate financing and economic stability. Pointing out the magnitude of the problem, Mr. Wickens indicated that half of the national wealth is represented by real property and that the real estate total debt is larger than any other type of debt. There are 30,000,000 families in the United States of whom more than half are real estate owners. Thus the volume of credit and the terms of credit have wide economic consequences. Real estate and building operations as usually financed over a period of years require fixed payments each year. The result of this is that as income falls in a community a much larger proportion of the total income must go into fixed charges in the real estate field. This has obviously unfortunate consequences. The condition is greatly aggravated as income is further curtailed. The greatest weakness of this financing plan is its inflexibility. The financing which is

taking place today in the real estate field is in this respect usually similar to that involved before the depression and which greatly aggravated it. Mr. Wickens indicated that a new type of credit instrument in the real estate field is greatly needed. Such an instrument would vary the annual payments with the level of income within the community. It was emphasized that this did not involve a variable interest rate, rather the cutting down during the depression period of the amount of fixed charges payable in those years and the proportionate or compensating increase in fixed charges during normal and prosperous periods.

"Social Security, the problem of insecurity and how to meet it" was the subject of the final chapter meeting of the year held on May 26th. The first paper was by Mr. Hugh Carter, Department of Sociology, Wharton School, University of Pennsylvania, who made an analysis of relief trends since 1900 for their bearing on social security. He stressed the accelerating rise in the burden of relief during the past 35 years and the impossibility of meeting the problem through private charity or local effort. He referred to studies of relief chiseling that indicated, contrary to popular belief, that very little public assistance was given to those not entitled to it. Mr. Carter emphasized the need for a comprehensive social security program integrated with an adequate public assistance program.

Mr. Ewan Clague, Assistant Director of Research and Statistics of the Social Security Board, analyzed the main provisions of the Federal Social Security Act of 1935. In discussing the old age provisions of the Act he pointed out that the age distribution of the population of the United States is rapidly changing due to the declining birth rate and this will give a seriously over-aged population. This abnormally large proportion of the aged will become more pronounced during the next two or three decades. The problems of administration connected with unemployment insurance were analyzed by Mr. Clague. He pointed out that a nation-wide system of unemployment insurance rather than entirely distinct systems in each of the forty-eight states as provided by the present Act would be simpler to administer. He indicated that the problems connected with migratory labor were being carefully studied with a view to working out a feasible system of unemployment reserves. Should pronounced localism develop, a serious problem will be created for the workers who move from state to state and for those workers who live in one state and work in another. The various grants in aid involving mothers assistance, aid to crippled children and others were described by the speaker.

Mr. Cyril James of the Department of Economics of the University of Pennsylvania analyzed financial aspects of the Social Security Act. In his view, the obligation of providing minimum economic security for the entire population is not open to question. From a financial standpoint it would appear to be preferable and much simpler to raise the necessary revenues for unemployment reserves, old age pensions and other necessary payments through increased income taxes, graduated downward to include the lowest income classes rather than through payroll taxes as is involved in the Social



Security Act. Professor James also questioned the wisdom of piling up reserves during years of prosperity and paying them out during years of depression. Such piling up of reserves invested in Federal securities would ease the money market and tend to lower interest rates during periods of prosperity when this is undesirable. Contracting of the reserves during periods of depression would have the opposite effect which is equally undesirable.

Mr. Frederick Stephan, Secretary of the American Statistical Association, discussed the work and purposes of the Association.

At the annual business meeting, the Chapter re-elected Mr. Casimir Sienkiewicz, Director of Research of the Philadelphia Federal Reserve Bank, as President; Mr. C. Parker Bursk, Department of Statistics, University of Pennsylvania, as Vice-President; and Mr. Hugh Carter, Department of Sociology, University of Pennsylvania, as Secretary.

**THE PITTSBURGH CHAPTER.**—A meeting of the Chapter held April 23 was addressed by Dr. Emil Lederer, sometime Professor of Political Economy, University of Heidelberg, and Dean, Graduate Faculty of Political and Social Science, New School of Social Research, New York. Dr. Lederer spoke on the subject, "Present Position in our Economic Cycle." Keen interest was evident in the many questions asked of Dr. Lederer when he had finished his address. The next meeting, held on May 28, was addressed by Mr. Mark S. James, Secretary-Manager, Pittsburgh Commission for Industrial Expansion, on the subject, "Why the Pittsburgh Commission for Industrial Expansion Was Formed." The Chapter held two meetings in June, the first in conjunction with the Economic Club of Pittsburgh and The Pittsburgh Personnel Association. This was a dinner meeting, held Thursday evening, June 11, at the Harvard-Yale-Princeton Club. It was a symposium on "Employment Problems under the Social Security Act and Unemployment Compensation Legislature in Pennsylvania." Dr. Francis Tyson, Professor of Economics at the University of Pittsburgh, presided.

The annual election of officers was held at the meeting on June 25. Mr. J. Blair Easter of John A. Beattie and Company was elected President. Mr. William R. Hamilton of West Penn Power Company was elected Vice-President and Mr. Frank M. Kenney of the Duquesne Light Company was nominated as Secretary.

**THE SAN FRANCISCO CHAPTER.**—"The Measurement of the Cost of Living" was the subject of a meeting of the Chapter on April 21, 1936. The speaker was Dr. Emily H. Huntington, Assistant Professor of Economics at the University of California, and Chairman of the Heller Committee for Research in Social Economics. The following is a summary of Miss Huntington's paper.

The United States Department of Labor, Bureau of Labor Statistics, has recently made certain important changes in its index numbers of the cost of living for wage earners and low salaried workers. The system of weighting has been changed in accordance with a suggestion made in 1931 by Margaret

Hogg. In computing the index numbers as published previous to 1935 the Department of Labor assumed that the distribution of expenditure in 1913, the base period, was the same as in 1917-1919, the year of the Bureau's country-wide cost of living study. This resulted in imputed weights for 1917-1919 which differed from those shown by the cost of living study. The reasons for this difference were the extreme and uneven price changes in the intervening period. In the computation of the corrected index number, the average cost of goods in 1913 equivalent to those purchased in 1917-1919 have been used to determine the weights. The result of this is a different set of weights in 1913 and the true weights for 1917-1919. This involves the assumption that spending habits were the same in 1913 as they were in 1917-1919. While this assumption undoubtedly does some violence to the facts it is certainly an improvement over the earlier method. The next step in the revision of the cost of living index will occur when the results of the consumption study now under way, which will presumably cover the period 1933-1935, are available. New weights can thus be computed based on more recent consumption habits.

The problem of splicing the index with the new weights to the one with the old weights is a difficult one. If 1923-1925 is to be used as the base year the new weights can be used in that year and thereafter, or the change may be allocated over the years from 1919 to 1923. Obviously all the change in consumption habits did not occur in the years 1923-1925, so that it would probably be preferable to compute the index number with the new weights back to 1918, compare it with the index with the old weights and distribute the difference over the period up to 1923-1925. It should be pointed out that there may have been greater changes in consumption habits after 1925 than before, but if 1923-1925 is to be the base period no part of the change in consumption habits can enter into the weights following that date.

Another problem of importance in the making of index numbers of the cost of living is the choice of commodities to be priced. Whether the method is to price sample articles in each category of expenditure as is done by the Bureau of Labor Statistics, or to price all of the items in a standard budget which is the method used by the Heller Committee for Research in Social Economics of the University of California, choices of articles to be included must be made.

A series of problems arise in relation to articles to be priced. Some articles disappear entirely from the stores, others, while still on the shelves, are seldom purchased. Again stores frequently discontinue a commodity of a given price and substitute one of a different quality. Another difficulty to be faced is that of a fixed price policy. Throughout a period of changing prices articles of clothing for instance are frequently sold at the same price. In such cases the quality has undoubtedly been changed. In these situations the same consumers probably substitute the commodity of a different quality for the one previously purchased. To them this means a change in cost of living but it is obviously not a change in the prices of identical commodities.

If the period for which the index number is being computed is short it

may be possible to price the substituted commodity back over previous years and thus secure an index number which measures both changes in prices and in cost of living. The makers of such index numbers, however, are always desirous of measuring changes over a long span of years. It is obviously impossible to compute a fixed base index number which will accurately measure both changes in prices over a long span of years and changes in consumption habits.

Over a span of years such as from 1900-1913, consumption habits may have changed as for instance by the addition of automobiles or radios in families of wage earners. There would be no justification for including the cost of these items for the entire period 1900-1933, nor would there be justification for adding them in any given year and comparing the cost of living with preceding years or even in distributing their cost over a period of years and thus assuming that the addition of an automobile or a radio has brought a gradual rise in the cost of living.

It appears impossible to compute an index number over a long span of years which measures both changes in prices and changes in standards. If the same articles continue to be priced, the resulting figure may be meaningless since the prices of new articles may not move in the direction of those used throughout the entire period. If new articles are added, comparisons of prices cannot be made with the period before the additions were made. Where drastic changes in consumption habits occur, the only way out of the dilemma would appear to be to discard the previous cost of living figures and set up a new base, prior to which the index would not be computed.

**THE WASHINGTON STATISTICAL SOCIETY.**—The annual meeting of the Washington Statistical Society was held on May 30, 1936, at the Cosmos Club. The Society was honored by the presence of the President of the American Statistical Association, Joseph S. Davis. President Mordecai Ezekiel presided. E. Dana Durand presented a report of the Nominating Committee and the following officers were elected: President, Ewan Clague, Associate Director of the Division of Research and Statistics, Social Security Board, and Vice-President, Spurgeon Bell, Director, Division of Research and Statistics, Home Owners Loan Corporation. Thomas B. Rhodes of the Works Progress Administration was nominated as Secretary.

The subject of the evening's program was "The National Income and What We Know About It." The principal speakers were O. C. Stine of the Bureau of Agricultural Economics; Clark Warburton of the Federal Deposit Insurance Corporation; and R. R. Nathan of the Bureau of Foreign and Domestic Commerce. The discussion was opened by Louis H. Bean of the Agricultural Adjustment Administration. A digest of the principal papers follows:

*Mr. Stine:* There are too many "national income" figures in circulation, and partly on this account it is too difficult for many to know much if anything about our national income. These national income estimates as a rule have distinguishing labels, but few people understand the significance of the

different descriptions or differences in labels. As a rule, each is an attempt to measure the national income and the difference in description is an indication of difference in approach and may or may not have great significance in indicating the differences in character of results. Some economists and statisticians argue that we need a variety of approaches and a considerable variety of results, and the problem is such that justification can be found for many different approaches and different estimates. The great variety that has developed, however, leads to confusion. The public should have one clearly defined and clearly labeled estimate of national income for common use. Comparable estimates should be provided annually for a period of years sufficient for making the comparisons that are usually wanted, and the annual estimates should be maintained currently and fairly closely up to date.

The subdivision or breakdown of a national income estimate should be in terms that are most significant to the public. The estimates should show from year to year changes in the incomes of large social and industrial groups which are commonly considered in relation to each other, such as agriculture, mining, manufacturing, and railroads, also significant changes in income per person by income-size groups.

This leads me to the point of income comparisons. The first requirement to be met is, of course, historical comparability, and the second most important requirement is to secure a fair degree of comparability among income producers or receivers. The work originally undertaken in the Department of Agriculture was primarily for the purpose of developing a measure of historical changes in the economic position of the farmer that was better than the use of price changes or changes in crop values. The temptation to make comparisons of income received from agriculture with income received from other sources led to the making of some comparisons of changes in wages and payrolls. This brought much criticism, some of which was warranted and some of which went beyond rational considerations.

You are all familiar with the recent developments in the agricultural field involving price and income estimates. To develop the point, let me review briefly the facts. The political struggle for improving the position of agricultural producers in relation to those engaged in other lines of activity inevitably led to attempts to estimate the degree of inequality suffered by agricultural producers or the disparity that existed. The Department of Agriculture refrained from pushing forward income relationships on account of the difficulty of making estimates of income from agriculture and from other sources on a comparable basis and because of the difficulty of rationalizing these relationships. Much was being said and written about price relationships as an indication of purchasing power. First the available indices were used, that is, wholesale prices of agricultural against nonagricultural products. The Bureau constructed an index of prices farmers received for agricultural products and for a time they were compared with the wholesale prices of nonagricultural products. The next step was to set up index numbers of prices of commodities farmers buy, and they were used, accepted by

some without question as to their significance, and condemned by a few who usually underrate their value. The Agricultural Adjustment Act simply legalized a procedure which was being publicly used as an indication of the disadvantage of agriculture in the depression. The use of price relationships drew severe criticisms as the prices of farm products were advanced sharply by curtailed production on account of the drought and the Adjustment Program. Now the Soil Conservation and Allotment Act gives us an income parity problem.

The income comparison required by the Soil Conservation Act is on an historical base. It requires reducing to a purchasing power basis the net income per person on farms and the income per person not on farms, in comparison with a pre-war base. This involves the construction of annual income estimates comparable with estimates of the pre-war base period, and a cost-of-living index which represents the change between the present and that base. At present this is looked upon as a great improvement in the basis for measuring the balance of welfare or parity relationships between rural and urban conditions of living. It provides an incentive for improving the estimates both of income and of changes in cost of living. I now predict that before long some other basis of comparison will be required. The pre-war base will be criticized as being too far behind present conditions. What may be considered a more real measure of urban and rural relationships will be sought. I predict that, next year or the year after, we shall be pressed for better measures of real income for both town and country.

It is very difficult to determine purchasing power in terms of real values. Five hundred dollars of income to the man on the farm has a real purchasing power quite different from \$500 in income to the man living in the city. And there is the additional problem of valuing goods and services not directly bought or hired. What values should be placed upon wide open spaces and scenery for the man in the country? He does not place a dollar value upon these things. He may place a dollar value on being close to the store, the post office, schools, and churches, but it is difficult to estimate these values. He is not buying them except by transportation costs to the village. Unquestionably the man in town must have more money to be as well fed as the man in the country. He must have more money to live as townspeople live, but with this he receives more service than does the farmer. The man of the town will pay something in the way of travel to get out into the wide open spaces and to have some of the scenery that the farmer enjoys free. Herein monetary comparisons fall down. Comparisons of relative changes are more valid, but still subject to criticism. The development of good roads, the extension of telephones and electric lines to the country have reduced materially the disadvantages of living in the country in the past few years, in comparison with pre-war. How can these changes be valued?

Coming back to a consideration of national income, let me offer a few suggestions as a starting point toward clarifying the field of income estimates for the public. Let there be one authoritative estimate of national income provided by a Government agency, with the several Government

agencies which are specializing in different fields contributing parts to the estimate of national income. Let the annual national income figure be an estimate of the net value of goods and services produced in the year. In computing this estimate, allowance should be made for maintenance of productive capacity and all duplications of values as between producing agencies should be eliminated. Changes in inventory should be included only in terms of net changes in physical volume, at current values, and shown separately in the breakdown of the estimate of national income. Goods and services for the year not entering into commercial exchange should be valued on the basis of current prices or charges for like goods and services, with due regard to the possibility of maintaining a reasonable degree of comparability through the period of years for which comparisons are most commonly made.

Annual national income estimates should be established for the period 1909 to date because of the frequent use of pre-war comparisons. Provision should be made for current preliminary estimates of national income for the year as early in that year as it is found possible to arrive at a figure that is likely to prove a fairly close approximation to the income of the year. It should be understood that the preliminary estimate is subject to check and revision within the following year; but the series should not be revised frequently beyond the revision of the last preliminary estimate.<sup>1</sup>

Establishing an authoritative annual estimate of national income, simply described and explained to the public, should not stand in the way of continuous research to improve basic elements in the estimates and to interpret or analyze the estimates. Let research workers produce other estimates of national income for special purposes, but label them carefully so as to avoid confusion in the public mind.

*Mr. Warburton:* Mr. Warburton stressed the importance of estimating the amount of the national income, or value of the national product, by the direct method of listing and evaluating the various items of consumption and of additions to capital facilities. Four purposes of such an estimate were emphasized. First, measurement of the national income in terms of end-products shows more clearly than any other method the essential characteristics of business fluctuations, revealing what segments of the economy fail in times of depression to produce their customary quotas of goods and services, and what segments are most stimulated in times of boom. Second, this type of measurement reveals the character of gradual alterations in the economy by indicating the changes in the proportions of the nation's productive energies devoted to each of the various kinds of end-products. Third, such a measurement is needed in connection with studies of productive capacity, since it is only when capacity to produce is related to the end-products which people wish to acquire that measurements of capacity have substantial significance. Fourth, this measurement provides a coordinated view of the national economy, and aids in placing an adequate emphasis upon the fact that the chief public purpose in governmental regulation of

<sup>1</sup>At this point the author has taken the liberty of extending his remarks in the record to carry out an idea to a logical conclusion.

or interference in economic life is to furnish to the people of the country the goods and services which they desire.

Mr. Warburton also mentioned a few of the difficult technical problems encountered in evaluating the various items of end-products: (1) inadequate information regarding retail values; (2) the difficulty of distinguishing between items purchased by consumers and those purchased by business enterprises; (3) evaluation of services such as education, medical service and relief provided by governmental authorities; (4) evaluation of illegal goods and services; and (5) separation of the net value of additions to capital facilities from the gross value, and the associated problem of segregating capital funds derived from capital gains and depreciation allowances from those derived from savings out of current income.

*Mr. Nathan:* The manuscript of a study of the national income, 1929-1935, prepared by the Income Section of the Bureau of Foreign and Domestic Commerce is now at the Government Printing Office. Data for 1935 will be ready in time to be added to the proof copy of the study. Also, the 1935 official estimates will be released shortly.

The National Bureau of Economic Research called a Conference on National Income and Wealth in January, 1936, with representatives of universities and both private and public research agencies in attendance, and arrangements have been made for a continuing organization of the Conference. The primary purpose of the Conference is the clarification of terminology, concepts, scope, etc., of income studies and the stimulation of research in this field.

It is possible to classify the national income in a great many ways. These classifications are of greater interest and importance than statements of the total income. For example, regional or geographic breakdowns of income data are exceedingly important. At the present time, it is only possible to make these breakdowns by states and these are only rough approximations; but it is hoped that at a later time the classifications can be made for areas which are relatively homogeneous in economic and industrial conditions. Nothing voluminous has been published on this basis since Maurice Leven's studies of 1929 and 1919-21. Monthly indexes of national income are also important and several of them have already appeared in the past year or so. The Bureau of Foreign and Domestic Commerce has been preparing a monthly index but it is not yet ready for publication.

Still more important are frequency distributions of income, not only by individual income recipients, but by families. There are some data which can be used for this purpose, but they are not entirely satisfactory and require careful analysis and experimentation. Among these data may be mentioned the financial survey of urban housing, the Federal income tax returns, the Federal study of consumers purchases now being conducted, and also a special tabulation and analysis of the Wisconsin tax returns which are important because of the low exemption limits. Ideally, a census of income is needed.

There is a great deal to be learned about the nature of the figures on

national income and their detailed characteristics. The Bureau of Foreign and Domestic Commerce is concentrating upon the improvement of estimates and the clarification of concepts. Improvements made by the agencies which are responsible for the collection of basic income data are reflected in the improvement of the estimates of the national income.

Among the more important problems in the field of national income estimates may be mentioned (1) the abuse of the estimates by the people who should know better and who might be expected to read the qualifying paragraphs which accompany the estimates, (2) the need for a clarification of terminology, (3) the complicated nature of the concepts, and (4) the contribution of government to the national income.

Mr. Bean, in discussing the statements made by Messrs. Stine, Warburton, and Nathan, pointed out: (1) that the provision in the Soil Conservation Act calling for a restoration of the prewar ratio of purchasing power of the net income per person on farms to the purchasing power of income per person not on farms has been utilized as a reason for stimulating research in farm and national income, and that a project has been set in motion in the Bureau of Agricultural Economics under funds supplied by the A.A.A.; (2) that it is necessary to bear in mind two types of research, the so-called "scientific research" that frequently is two or three years behind the time and "operating research" to meet the needs of agencies engaged in shaping current and future policies and responsible for action. "Operating research," as Mr. Bean defined it, consists of utilizing the best results available from "scientific research" and supplementing by additional research that calls for anticipating or approximating the truth, subsequently to be revealed by "scientific research" as closely as possible. He argued that in practical affairs where action must be taken whether by private or governmental agencies, a 90 per cent approximation today is better than a 95 per cent approach to the truth by "scientific research" two years after the need has passed. Mr. Bean illustrated his remarks with a chart showing national income (exclusive of farm income) by months from 1921 to date, together with the course of retail expenditures for livestock products, both series prepared by the A.A.A. and published in the April 1936 issue of the *Agricultural Situation of the U. S. Department of Agriculture*.

In the general discussion it was pointed out that it would be valuable to have several estimates to suit different purposes, in spite of the confusion of terms and concepts which accompany them. It was shown that in the preparation of estimates important items in the national income might very easily be overlooked or duplicated. With respect to the demand for statistics before they can be prepared with scientific accuracy, one discussant pointed out that statisticians are largely to blame since they have conveyed to Congress the notion that statisticians can furnish figures almost instantly which are adequate for the basis of legislation vitally affecting great masses of people. Another discussant remarked that, "Many of us are reluctant to say, 'We just don't know. We cannot afford to give you a figure that can only be abused.'"



## STATISTICAL NEWS AND NOTES

**SECURITIES AND EXCHANGE COMMISSION.**—During its second year (ended June 30, 1936) the Securities and Exchange Commission has considerably expanded the scope of its statistical activities. However, so far only a small part of the material collected has been released for publication. The more important statistical data released (for statistics released before June 30, 1935, see this JOURNAL, vol. 30, 1935, pp. 608–609), include:

1. Figures on purchases and sales of certain groups of members of the New York Stock Exchange and the New York Curb Exchange during the period from June 27 to December 18, 1935, contained in the Commission's report on "The Feasibility and Advisability of the Complete Segregation of the Functions of Broker and Dealer." Comparable figures have been regularly reported to the Securities and Exchange Commission since March 2, 1936 and may be released soon.

2. Data on brokers and dealers in securities registered with the Securities and Exchange Commission (Release No. 523).

3. An extensive list of about 27,000 reports by officers, directors and principal stockholders of about 1,800 corporations with securities fully listed on a registered securities exchange as at December 31, 1935, on their holdings in equity securities of such corporations was published by the Commission, together with certain summary statistics based on these data, in July, 1936; more detailed statistics may be released in the near future.

The statements filed by approximately 2,000 corporations in connection with their registration under the Securities Exchange Act of 1934 are being analyzed in a WPA project, "Census of Listed American Corporations," supervised by the Securities and Exchange Commission. It is expected that a considerable amount of statistical data will be released in the fall.

Comprehensive statistics on investment trusts and investment companies have been collected in connection with the Commission's study authorized by Section 30 of the Public Utility Act of 1935. Part of this material will most likely be included in the report which the Commission has been ordered to render to Congress on or before January 4, 1937.

**BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM.**—The Board of Governors of the Federal Reserve System appointed George W. Blattner, who has been a member of the Board's research staff since 1929, an Assistant Director of the Division of Research and Statistics, effective May 1, 1936. The principal lines of work of the division will be in charge of the three assistant directors as follows: Credit and business developments, under Woodlief Thomas; monetary problems, under Lauchlin B. Currie; and problems of bank structure and supervision and statistical work of the Reserve banks, under Mr. Blattner.

The Board's seasonally adjusted index of factory employment is being revised on the basis of the revised unadjusted index recently published by the Bureau of Labor Statistics. Revised seasonal adjustment factors and

seasonally adjusted indexes are to be published by groups and by industries in the current issue of the *Federal Reserve Bulletin*.

**FEDERAL DEPOSIT INSURANCE CORPORATION.**—The Annual Report of the Federal Deposit Insurance Corporation for the year 1935 has been issued. The report is similar in form and content to that issued last year, and describes the changes in deposit insurance structure and in the operations of the Corporation resulting from inauguration of the permanent plan of insurance provided for in the Banking Act of 1935. The report also contains more detailed information than has heretofore been available regarding the size and class of banks, branch banking, changes in banking structure, bank earnings and profits, and examiners' appraisals of the condition of banks.

**FEDERAL TRADE COMMISSION.**—Recent reports of the Federal Trade Commission include several which are of interest to statisticians.

A short report with a long title, on milk, was recently sent to the Congress, namely, Report of the Federal Trade Commission on Milk Market Regulation and Practices of Distributors in Relation to Margins, Costs and Profits of Distributors in Boston, Baltimore, Cincinnati, and St. Louis.

The textile inquiry of the Commission, which apparently will end next December with a report on the results for the first half of 1936, continues to furnish reports from time to time, which sometimes include special features besides the standard data. The general data and comparisons go back to the beginning of 1933. Among the more recent reports sent to Congress, is one entitled Woolen and Worsted Textile Industries, first half of 1935, which contains novel data on costs per yard and per pound. A report was also recently issued covering Cotton Textiles for the same period.

The Congress just before adjournment passed the Gearhart resolution regarding fresh fruits, vegetables, etc. (Public Resolution No. 112, 74th Congress). This extends the scope of the so-called Agricultural Income inquiry which includes among other things comparison of farm income with that of corporations manufacturing, processing and distributing farm products, the partition of the consumer's dollar paid for such commodities among the various factors of production, etc.

The Congress also passed a resolution calling for a new inquiry into the farm implement and machinery industry (Public Resolution No. 130, 74th Congress). Among the statistical data called for are prices, including comparisons with the prices of other commodities and also costs, margins and profits.

No appropriation, however, was made for these two studies and the effect on their progress is more or less a matter of speculation.

**BUREAU OF FOREIGN AND DOMESTIC COMMERCE.**—A revision and expansion of that portion of the *Market Data Handbook* (1929) dealing with consumer statistics was available for distribution late in June. This *Consumer Market Data Handbook* presents in a practical manner the more important statistics necessary to an evaluation of the consumers' market. Much data

is given for towns of 2,500 population and over, others by counties and states. Sources of other pertinent statistics are also given.

The annual number of the *World Economic Review*, which was published during June, presents in summary form the outstanding economic developments in 1935. The progress of economic recovery throughout the world is shown in the present study. It also discloses that, although substantial progress toward recovery has taken place in the United States, such progress was characterized by considerable unevenness. The major trends are reviewed, together with a summary of the principal adverse factors which are still exercising a drag upon recovery.

In the near future it is expected that the 1936 supplement to the *Survey of Current Business* will be available. This volume will present monthly figures from 1932 to 1935 inclusive, as well as monthly averages, were available, from 1913 up to and including 1935. The previous supplement (1932) contained monthly data from 1923 to 1932. Due to the addition of new series and the revision of existing ones, many changes have occurred in the various time series during the past four years.

The study of "Long Term Debts" has been completed by the Division of Economic Research and will be available shortly. As reported in the last issue, this study will deal with (1) changes in the volume of long-term indebtedness since 1913 by principal classes of borrowers, (2) changes in annual interest charges, (3) the volume of obligations in default at different dates, (4) comparative ages of the classes of debt outstanding in 1933, and (5) the ownership of the evidences of debt.

The Division has also published a comprehensive volume on *National Income 1929-1935* showing estimates for twelve major industrial divisions and about 40 subdivisions. The book includes estimates of the number of persons employed and their per capita income; also classifications of income by types of payment. The July issue of the *Survey of Current Business* contained an article "Expansion of National Income Continued in 1935," reprints of which may be obtained from the Division of Economic Research.

Regular monthly releases are now being made on manufacturers' and wholesalers' sales and collections on accounts receivable by kinds of business; also by geographic areas for the wholesale data. This program is being carried out in cooperation with the National Association of Credit Men.

The annual *Retail Credit Survey* containing 1934 and 1935 data for more than 1,500 firms in some 88 cities, has been released. Among other significant facts, it is shown that (1) payments on both open and installment accounts receivable were made more promptly during 1935 than in 1934, (2) the ratio of credit sales (open account and installment combined) to total sales increased for twelve of the fourteen kinds of retail stores studied, and (3) that bad-debt losses decreased materially in 1935, being only about one-half of the 1934 ratio.

The States of Arkansas, Iowa, Kansas, Missouri, and Nebraska have been added to the nine already being covered by the Bureau's independent retail sales reporting program. It is planned to add to the service very soon the

six New England States (Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island).

The first of a series of publications on "Basic Industrial Markets in the United States" was released in June. This series is designed to offer industrial marketing executives a quick and accurate picture of the size and location of those sections of their markets represented by the various basic industries. The first volume in this series covers textiles.

"The Balance of International Payments in 1935" has been published by the Finance Division, which Division also issued (in June) a special circular (No. 417) analyzing the approximately five billion dollars of "Foreign Investments in the U. S."

"The Construction Industry" published last April was the first of a series designed to present in summary form information of specific industries as well as the leading trade associations within the industry. "The Foodstuffs Industry," the second of this series is in press and a bulletin on "The Lumber Industry" is in preparation.

"Markets for Electrical and Gas Facilities" has been completed and "Markets for Plumbing and Heating Facilities in Residences" is in press.

The Bureau has recently completed a study of "Store Modernization Needs" based upon a physical appraisal of some 8,000 small stores in 23 selected cities. A check sheet by which a merchant can evaluate his own needs and plan of business is attached to this volume.

The widely-used studies of the Bureau, "Consumer Use of Selected Goods and Services, By Income Classes," constitute the first primary research of its kind based upon substantial samples. The nine reports issued to date provide information on 1933 income and use of "durable goods" items by a representative number of families in Austin, Tex.; Fargo, N. D.; Portland, Me.; Columbia, S. C.; Salt Lake City, Utah; Trenton, N. J.; San Diego, Calif.; Racine, Wis.; and Birmingham, Ala. (10 cents each, Bur. For. & Dom. Com.). The next report will include (in one publication to be released this Fall) similar data for each of nine other cities evenly distributed throughout the United States. (Burlington, Vt.; Casper, Wyo.; Des Moines, Iowa; Erie, Pa.; Frederick, Md.; Lansing, Mich.; Paducah, Ky.; Portland, Ore.; Oklahoma City, Okla.).

An "Estimate of the Volume of Wholesale Trade in the United States, 1899-1935" by N. H. Engle, Assistant Director of the Bureau, appeared in the May issue of the *Survey of Current Business*. Reprints are available.

A revised edition of a study of the "Outstanding Factors Affecting Foreign Trade Policy" was published in May.

Domestic Commerce Bulletin No. 94 on "Confectionery Production and Distribution, 1935" was released in June. "A Review of the American Machinery Industry" also appeared during this month.

**BUREAU OF AGRICULTURAL ECONOMICS.**—Revisions for acreage, yield, and production of certain major crops for the years 1924-35 have been made by the Crop Reporting Board, U. S. Department of Agriculture, and are avail-

able in mimeographed form. These revisions were made after consideration of the enumerations of the Census of 1935.

A new series of mimeographed reports on special phases of the work of the Division of Crop and Livestock Estimates was begun in late May with the issue of an article entitled "Effective Precipitation in Relation to Crop Yields," by Anna P. Kelly and Joseph L. Orr. Others of the series will be issued occasionally.

"Livestock Meats and Wool Market Statistics and Related Data, 1935" has been completed and is now available. The favorable reception of the first two editions has encouraged the authors to prepare additional matter, besides bringing customary tables through 1935. Special attention has been paid to long-time series.

The agricultural statistics which for years have been carried in the *Yearbook of Agriculture* will this year be available as a separate volume, entitled *Agricultural Statistics, 1936*.

Cost of crop insurance is being studied in a research project of the Division of Agricultural Finance by William H. Rowe, assisted by E. L. Cady of Iowa State College. Work in Kansas, Oklahoma, Texas, Nebraska, North Dakota, and Montana is contemplated, based for the most part on data acquired by the Agricultural Adjustment Administration incident to the adjustment programs.

INTERSTATE COMMERCE COMMISSION.—The Interstate Commerce Commission has begun issuing statements of estimated monthly revenues of railways, freight, passenger, and total, for the Eastern, Southern, and Western districts, giving percentages of increase over same month of previous year about three weeks in advance of the totals compiled from the final sworn reports. The new statement is based on the estimates furnished by such individual railway companies as regularly compile them for their own information.

DIVISION OF ECONOMICS AND STATISTICS, FEDERAL HOUSING ADMINISTRATION.—This Division, in cooperation with the Large Scale Housing and the Comptroller's Divisions of the Federal Housing Administration, is conducting a study of the operating experience of apartment houses throughout the country. The schedules have been planned to embrace into a single uniform system a wide variety of accounting methods. The main breakdowns may be classified according to three divisions: (1) yearly statements of assets, liabilities and capital, incomes, expenses; (2) analyses of dwelling units (furnished, unfurnished, rental charged), replacements, indebtedness, pay-rolls, repairs; and (3) miscellaneous information, including square foot area, cubic content, space devoted to stores, type of building, services provided, and a short history and description of the neighborhood. Representatives of the Federal Housing Administration are transcribing data from organization records to the schedules. Almost 500 New York and Chicago apartment buildings, each containing a minimum of eighteen dwelling units, are being

studied at the present time. The field work of gathering data on 100 apartment buildings in Washington, D. C., is under way. The project may be broadened to include an equal number of buildings in one Southern city and in one Western city. It is hoped that, through the development of a uniform system of accounting as well as more comprehensive analyses of these data, a deeper understanding of revenue trends and costs of operation may be reached, and that aid may be given to stabilizing the market for multiple family houses. A "Uniform System of Accounts" for large scale housing projects has been prepared and published.

The manuscript of a study entitled "Financial Analysis of Large Scale Housing Projects" has recently been completed, having as its object the development of a method by which the economic soundness of a housing project may be tested, and by which the adequacy of the predicted revenue in meeting cash requirements under a financial plan may be measured. This analysis takes cognizance of the fact that the relationship between debt and value at the initiation of a project is an inadequate measure of the security for the loan throughout the term of the loan. The procedure is designed to show whether a particular financial plan under a given revenue assumption can be successfully undertaken without undue risk. Should the selected plan appear to be too burdensome, the technique will measure the change necessary in any given one of its elements in order to make it conform to the productivity pattern of the project. The method followed is, first, to define the various forces affecting the financial situation in which the project is to operate; second, to test the economic soundness of the project by comparing the actual capital cost with the investment-amount justified by a refined income appraisal extending over the economic life of the project, and finally, to analyze the financial plan so that the predicted balance available for debt service thus obtained may be tested in the light of the annual repayments required by the proposed financial plan.

An analysis of family rental expenditures in relation to family incomes in 43 cities has been completed. The analysis is based on the data presented in the Financial Survey of Urban Housing conducted by the Bureau of Foreign and Domestic Commerce. The purpose of the analysis has been to secure a measure of the customary family expenditure for housing at various income levels which will provide a basis for the adjustment of amortization schedules to suit the income of the borrower and to determine the validity of Engel's expenditure laws with respect to housing. The results of the analysis will be published in the near future.

The actuary of the Division has prepared two sets of yield tables for 5 per cent monthly amortized mortgages. The first set of tables shows the yield earned on these mortgages for terms of 10 to 20 years purchased at or above the amount due on the mortgage. The assumed purchase price varies from 100 per cent to 110 per cent of the balance due. The second set of tables shows the yield earned on these amortized 5 per cent mortgages purchased at the unpaid balance for varying terms of mortgages, and exchanged for 3 per cent debentures upon default of mortgage payments. Both of these

sets of tables are shown on the semi-annual conversion basis, the customary basis for quoting yields of bonds, as well as on the effective annual basis.

The Washington, D. C., Real Property Inventory, the data for which were gathered in 1934 under the auspices of the Civil Works Administration, has recently been tabulated as a Federal Works Progress Administration project in Philadelphia under the sponsorship of this Division. Insofar as possible the tabulations outlined in the "Technique for Real Property Survey" (discussed in the Statistical News and Notes Section of the December, 1935, issue of this JOURNAL) have been adapted to the original schedules. Tabulations by city blocks and by census tracts and a detailed tabulation for the city as a whole have been made. In addition, the study includes maps presenting average rent, condition of structure, race, and other pertinent factors for each city block.

The field enumeration in connection with the financial survey of housing in Kansas City, Kansas, was completed last year. The data were gathered under the supervision of this Division as a Works Progress Administration project. Practically all tenants and all owners of residential property have been covered by the project. The survey contains a number of revisions in the schedules and in the tabulations as contrasted to former surveys of this type. The tabulation and analysis will be completed in the near future.

A technique is being developed which should prove valuable to governmental agencies concerned with housing construction and financing, and to private institutions investing in mortgages or real estate. Its purpose is to provide a method of preparing a detailed analysis of real estate transfers, real estate mortgages, distress sales of real property, and lots subdivided or platted, on the basis of material available in the official records of the local government. It is hoped that the technique will be adopted in surveys carried forward as Works Progress Administration projects in a number of cities throughout the United States.

UNITED STATES BUREAU OF LABOR STATISTICS.—A study of the legal-aid movement in the United States, prepared by Reginald Heber Smith and John S. Bradway, has just been published as a Bureau bulletin. It represents a complete revision of the earlier bulletin on the same subject, issued in 1926.

Bituminous coal mining and shipbuilding will be the next of the major industries to be covered by wage surveys, according to present plans. The survey of entrance wage rates of common labor, made each July by the Bureau, will be extended this year to cover a number of industries not included in former surveys.

The Bureau is undertaking a revision of its directory of cooperative societies, last issued in June 1934. In this work other Federal agencies are cooperating. Thus a much wider coverage is expected to be obtained than has heretofore been possible. On the basis of the data obtained, a statistical survey will be made later.

Beginning with July, the reporting of retail food prices was changed from a bi-weekly to a monthly basis. This was made necessary by a reduction in

the Bureau's appropriation for the current fiscal year. Also, as a measure of economy, arrangements are being made with a number of cooperating State offices by which much of the tabulation in connection with the monthly employment statistics will be done in those offices instead of in Washington.

Surveys of operations under the old-age and blind pension acts of the various States in 1935 have been completed. Reports on both will appear in the *Monthly Labor Review*. The Bureau has been collecting data on old-age pensions each year beginning with 1928, but blind pensions were covered for the first time in 1934.

UNITED STATES EMPLOYMENT SERVICE.—*Second Nationwide Survey of Registered Job-Seekers*: Since November, 1935, the United States Employment Service has been engaged in the establishment of an organization for securing periodic detailed inventories of all job-seekers registered with public offices throughout the country as actively seeking work. Through this Inventory Program a complete punched card file giving detailed information concerning the individual job-seekers has been established and integrated with the regular reporting system of the Employment Service. The first nationwide survey of job-seekers made through this organization was completed early in July. A second nationwide Inventory survey of active job-seekers is being taken covering the records of all applicants actively registered with Employment Service offices on July 1, 1936. Work on the tabulation of this material is now well advanced. It is expected that final tabulations of the material will be completed late in September.

The reports made available through the analysis of the active file records of employment offices give the detailed classification of the industrial background in which applicants were formerly normally employed, the occupational classification in which they are seeking employment, their age and, in the case of veterans, their classification with respect to dependency and disability status. These tabulations are prepared on the basis of individual cards prepared for each applicant and are maintained strictly up to date through the operations of the regular reporting system of the Employment Service.

The tabulations of the active file inventory for the Employment Service comprise one of the largest current samples of detailed information concerning the characteristics and distribution of job-seekers in existence. The inventory records cover not only unemployed job-seekers but all persons working at security wages on relief works projects and also a small proportion of person employed but seeking better work opportunities.

Offices of the United States Employment Service, whose active file records are tabulated in these inventory surveys, are operated in every sizeable community in the country. Through an integrated system of affiliated state employment service offices and supplementary National Reemployment Service offices operating under the direction of the United States Employment Service, reports are prepared in accordance with a uniform standard



reporting procedure. The observance of the standard reporting procedure and the fact that reports are prepared by an experienced and trained personnel insures that the information received throughout the country is available on a uniformly comparable basis. Tabulations are prepared for each state and for each employment service district in the country.

The existence of these nationwide surveys of job-seekers provides a hitherto unavailable source of information. By means of these reports it is possible to make studies of the varying conditions in different sections of the country and to contrast the characteristics and distribution of the various age, relief, occupational and industrial groups. Each of the basic tables contains cross-classifications indicating sex, color, relief and veteran status. By this means it will be possible to obtain the information for any one of the sub-groups which is given for the main table. Thus, for instance, the age tabulations of relief men and relief women can be contrasted with those of the non-relief group, etc.

Information secured through the Inventory surveys is available for use in two forms. At the conclusion of each survey a digest of the results for the entire country is published by the Division of Standards and Research, United States Employment Service, in Washington. This report includes complete tables of nationwide figures and also indicates the distribution of applicants through the various states. The detailed figures for the individual states and for communities within each state are available through the offices of the respective state directors of the Employment Service. In addition many state services have issued brief summaries of the inventory reports prepared for their localities. In case any difficulty is encountered in securing desired information, communication should be addressed to the Associate Director for Standards and Research, United States Employment Service, Department of Labor, Washington, D.C.

*Occupational Research Program:* A recent issue of the JOURNAL described the objectives of the Occupational Research Program which the Employment Service is conducting. The Program has recently completed descriptions of jobs in the following industries in addition to those previously announced: Retail Trade, Foundry and Machine Shop, Hotel and Restaurant, and Domestic and Personal Service. Trade questions for thirty occupations in the construction industry have been standardized and are ready to be published in suitable form for employment office interviewers. The questions after being collected and edited were tried out on skilled workers in the various trades and also on persons in closely related occupations. Questions which differentiated the respective skilled groups significantly from other groups were retained.

Several studies have been completed in an effort to discover objective means of measuring the potentialities required of workers in three clerical occupations and in certain department store sales positions.

**DIVISION OF SOCIAL RESEARCH, WORKS PROGRESS ADMINISTRATION.—**  
*Special Inquiries.* Several special inquiries have been undertaken within

the past few months designed to show the effects of the Works Program as a whole and of certain administrative policies on workers in selected communities. Surveys of workers certified for Works Program employment were conducted in 15 cities and one rural area; the information assembled includes reasons for failure of workers to take employment on the Program, duration and continuity of Works Program employment, monthly earnings, and supplementary relief received. Reasons for failures to accept assignments to Works Program employment are reported in two bulletins, one for urban and rural communities of Ohio and the other for the 13 cities included in the survey of former urban relief cases. Separations of workers from Works Program employment were studied in order to ascertain the reasons why workers left their Works Progress Administration jobs and their ability to get along subsequently. Additional studies of this nature are planned for the future.

Charges that Works Progress Administration workers are unwilling to accept available private jobs have been investigated in a number of areas, notably Colorado, Montana, Utah, and New York City. Similar surveys were made last year in six communities covering a variety of rural and urban industrial situations.

Following the cessation of grants from the State administration, a comprehensive survey was made of the relief situation in twelve New Jersey communities. Data were obtained on incomes before and after the closing of emergency relief administration cases and the current economic status of cases as indicated by diet, housing, and immediate, urgent needs.

*Studies of Relief and Welfare Legislation.* A study of legislative trends in public assistance, 1929-1936, and a digest of poor relief laws in the several States and territories have recently been completed. An historical study of general relief legislation (48 States) and a study of trends in welfare expenditures in eleven selected States is in preparation. Digests of State legislation and administration provisions for public assistance are being published for all States and territories.

*Survey of Rural Youth.* A complete population enumeration and a detailed study of all youth 15-29 years of age in 45 of the 140 villages included in the Re-survey of Agricultural Villages is now in process. This survey has been made possible by a grant from the American Youth Commission, under the American Council on Education. Disbursement of funds will be handled through the Columbia University Council for Research in the Social Sciences. The field work is the responsibility of the Works Progress Administration State Supervisors of Rural Research and should be finished before the end of the summer.

*Study of Migratory Workers.* An analysis is being made of the work histories of several hundred migratory-casual workers for the years 1933 and 1934. Cases have been selected to furnish examples of the travel routes, occupations, periods of employment, earnings, etc., for workers included in the casual labor force of the various States.

*Bulletins and Reports.* Preliminary figures showing the relative cost of

living in 59 cities in the United States are presented in Research Bulletin Series I, No. 20. A report on unemployable relief cases in thirteen selected cities has been released as Research Bulletin Series I, No. 19.

At this time twenty reports are in preparation for issuance in monograph form during the present year. These reports concern surveys and studies for which some preliminary findings have been published in bulletin form during the past two years.

**DIVISION OF RESEARCH, STATISTICS AND RECORDS, WORKS PROGRESS ADMINISTRATION.**—In previous issues of this JOURNAL comment has been made on various aspects of the system of statistical reports covering the Works Program which is the responsibility of the Works Progress Administration and particularly of its Division of Research, Statistics and Records. This system involves not only reports on the activities of the Works Progress Administration but also reports on the other Federal agencies having administrative responsibility for work projects financed through the Emergency Relief Appropriation Act of 1935. The following paragraphs summarize the various phases of this reporting system.

*Reports Received from the Area Statistical Offices.* In the Area Statistical Offices regular reports on the Works Program are prepared currently from operating and accounting documents received from Works Progress Administration state or district offices and from projects of other agencies engaged in the program. Two reports, both of which cover other Federal agencies participating in the Works Program as well as the Works Progress Administration, are of outstanding importance. A semi-monthly report shows the total number of persons employed by sex, the total hours worked and credited, and total earnings. In addition, the total number of persons, hours on which payment was based and earnings are shown separately for persons from the relief rolls and those not from the relief rolls. These data are given by counties separately for the Works Progress Administration and for each other Federal agency. Another report shows the number of different persons working at any time during the month on projects for the Works Progress Administration or any other Federal agency. This report is prepared by county of residence of persons employed and shows the number of persons by sex and by previous relief status.

Other regular reports present in more detail special aspects of the Program. In addition, current reports are made covering such information as purchases and contributions of materials, classified both by type of materials and type of project on which used; purchases and contributions of rentals and services other than materials; and sponsors' funds made available for the Works Program.

Special reports are prepared by the Area Statistical Offices from time to time at the request of the Washington Office. Numerous documents such as copies of payrolls, purchase orders, and employment records for each person assigned to the Program are on file in the Area offices. In some instances, therefore, it is possible to conduct large tabulations on a sample basis.

since the documents are centralized. Among the more important of the special reports is that on Works Progress Administration projects selected for operation showing the number of projects selected in each State since the beginning of the Program, their total approved cost estimate including both Works Progress Administration and sponsors' funds, and the estimated direct labor costs as compared with other operating costs (materials, supplies, equipment, etc.), each classified according to type of project. Another tabulation is that made from the individual employment records maintained for each person assigned to a work project. This summary includes total employment, both by type of project and by occupational classifications, assigned monthly wage rates, and actual monthly earnings for persons employed on projects of other Federal agencies as well as of the Works Progress Administration.

*Data Covering Works Program Activities of Other Federal Agencies.* Statistics maintained by the Division of Research, Statistics and Records, covering the activities of other Federal agencies, involve primarily employment and payrolls, accounting and financial data, and data on the physical status of projects. Payroll documents similar to those covering Works Progress Administration employment are routed to the Area Statistical Offices from Federal agency projects. Owing to the time lag necessary for tabulation of data from these payrolls and in order to provide more immediate information on employment, each agency reports an employment count to the Works Progress Administration five days after the close of each week. Accounting and financial data covering each agency are based on records maintained by the Treasury Department, which provides cumulative figures on allocations to each agency as well as obligations incurred and expenditures made by it. The Division maintains a detailed record of the operation status of the several thousand projects conducted by other agencies. Starting with the Presidential letters of approval, containing information on funds allocated for the projects, their location, and miscellaneous descriptive material, this record also covers subsequent data on the award of contracts, the physical progress of each project, and, finally, the completion of the work.

*Research Activities.* The Division of Research, Statistics, and Records of the Works Progress Administration has inaugurated an investigation into the relation between the various relief programs and the status of labor in the country. During the summer months a group of economists has been studying the relief problem in its relationship to the status of labor in thirty-three communities in the United States.

In connection with the conduct of this investigation a study has been made of the methods of establishing prevailing rates which have been used by various agencies of the Federal government and under the various state laws. Data have also been gathered on rates of wages for the entire country. These data are being recorded on standard cards in order that they may be useful not only for the purposes of the investigation but for the use of any other agency. Several other Federal agencies, especially the Bureau of Labor

Statistics, have undertaken to cooperate with the Works Progress Administration in conducting statistical studies of actual rates of wages throughout the country.

Another phase of the research work of the Division involves a comparison and analysis of trends in employment and trends in relief in a number of local areas where reasonably adequate data are available. At present the analysis includes Philadelphia, Pittsburgh, and a number of counties in Ohio. The analysis will be extended to other local areas where adequate data permit such a study. This investigation covers, for the most part, the period 1932-1935. The paucity of suitable relief data before 1932 makes it virtually impossible to study these trends during the course of the entire depression. This analysis of employment and relief trends will attempt to compare areas of markedly different industrial instability characteristics. This involves comparing relief and employment trends in areas dominated by durable goods industries with areas producing predominantly non-durable goods.

A comprehensive analysis of construction statistics is also being undertaken by the Division.

*Continuation of Relief Statistics.* As the result of an attempt to continue in modified form the reporting procedures established by the Federal Emergency Relief Administration, the Works Progress Administration has established cooperative relationships with most states and is now obtaining reports comparable with those obtained for 1933-35 from about three-fourths of the states.

In many states Departments of Public Welfare, which administer general assistance together with aid to the blind, the aged, and to dependent children, have established adequate reporting procedures which cover all general relief from public funds. In other states, in which the continuation of the state emergency relief administration is assured, reporting procedures have changed very little; however, in a few of these states the decline in the number of families receiving unemployment relief has reduced the proportion of relief administered through the emergency relief administration and made relatively more significant the general outdoor relief administered by local officials. It has been possible to obtain supplementary reports on such relief through the state emergency relief administration in several states, but in others inadequate staffs in the state organizations have made this impossible at least for the time being. In twelve states no state funds have been provided for general relief so that financial responsibility lies entirely in the hands of local officials; no central administrative organization is provided and no statistical reports are obtainable at the present time.

The fact that special sessions of legislatures may change the status of relief administrations makes it difficult to predict the future status of relief statistics but it is probable that for the rest of the year a group of states which includes about three-fourths of the population of the United States will be able to furnish reasonably complete and comparable reports.

NATIONAL RESEARCH PROJECT, WORKS PROGRESS ADMINISTRATION.—In the preliminary outline of the study of *Re-employment Opportunities and Recent Changes in Industrial Techniques* a program was laid out for investigations along the following lines:

1. Plant surveys of changes in productivity in certain industries.
2. Statistical studies of changing productivity.
3. Surveys of occupational and social changes.

Work is progressing along all three lines of activity.

*Plant Surveys of Productivity.* Productivity studies are being conducted in a number of interrelated industries selected in order to make possible a composite picture of the effect of technological and managerial changes. These studies will cover selected portions of manufacturing, mining, transportation, agriculture, and other industrial groups. Most of the studies are being carried on in cooperation with other agencies. The Bureau of Labor Statistics is cooperating in surveys of the following industries: boots and shoes, leather, textiles, automobiles, iron and steel, plate glass, and rubber tires. The National Bureau of Economic Research is collaborating in a more comprehensive survey of industries previously examined by the Bureau: brick and tile, cement, lumber, beet sugar, and flour milling. In the extractive industries the Bureau of Mines is assisting in the tabulation of information which it has already collected. These data will be supplemented by field surveys wherever necessary for a more complete picture.

Changes in production methods in agriculture together with their effect on the number of workers required and the volume of production are being investigated by field surveys in selected crop areas. A technical committee set up by the Bureau of Agricultural Economics is cooperating in the direction of this work. Working agreements are under discussion with other Federal agencies.

*Statistical Studies of Changing Productivity.* A statistical staff is engaged in the assembly and evaluation of all available data on employment, man-hours, and production in various industries, including manufacturing, agriculture, transportation, communication, mining, etc. This section is examining the limitations of available statistics, making necessary adjustments wherever possible and constructing productivity indices. In addition, the staff will attempt to estimate the amount of unemployment resulting from technological and managerial changes.

*Surveys of Occupational and Social Changes.* Sociological surveys are being made to gather information on the occupational histories of selected groups of displaced workers and on the characteristics of various types of stranded communities. The studies are designed to provide a factual basis for analysis of what has happened to displaced workers.

The Industrial Research Department of the University of Pennsylvania is collaborating on a study of work histories in Philadelphia. Material on occupational and social history is being obtained from field studies and from the Philadelphia State Employment Office records.

Arrangements are under way to obtain data on occupational shifts from schedules used in surveys conducted by the United States Public Health Service, the Bureau of Foreign and Domestic Commerce, the Milbank Memorial Fund, and the Bureau of Education. Tabulation of data from the files of the Civil Service Commission is also contemplated.

The majority of the field surveys of stranded communities will be conducted during the summer, utilizing students and faculty members of various universities from which previous surveys of a similar nature have been undertaken. Among these institutions are Harvard University, Smith College, University of Illinois, University of Wisconsin, and Newark University.

*Supplementary Activities.* In conjunction with the field surveys of productivity changes and of social consequences of displacement, it is planned to assemble and evaluate whatever previous investigations have been made along these lines. To this end research staffs have been functioning in the several fields gathering published and unpublished material available in the files of various government and private agencies.

**WOMEN'S BUREAU, U. S. DEPARTMENT OF LABOR.**—A Women's Bureau bulletin on "The Employment of Women in Department Stores" is now in press. This study shows conditions in the general mercantile industry prior to the Retail Trade Code of the NRA, the source being data obtained from 46 stores in 17 cities in 5 states. In addition to wage and hour and personal data for the individual employee, the study covers certain policies of management as to changes in method of pay and in hours, source of extras, and spread-the-work plans that were prevalent in late 1932 or early 1933. Information on hours and wages is published for six areas: New Jersey, Little Rock and Fort Smith, Denver, Los Angeles, San Francisco and Oakland, and Seattle.

Also in press is a report on "Piecework in the Silk Dress Industry." This study shows the effect of a minimum weekly wage on the earnings of pieceworkers, together with production variations under uniform hours in 9 dress centers, namely, New York City, the Eastern Area (including the suburbs of New York, New Jersey, and Connecticut), Boston, Philadelphia, Cleveland, Chicago, St. Paul and Minneapolis, St. Louis, and Los Angeles. Pay-roll records were obtained from 305 establishments for a 4-week period in the spring of 1933 before the union agreement or the code had been established, and for a 4-week period after the new hour and wage provisions had become effective. Corresponding production records were obtained from books kept by the workers themselves, and in some cases from the books of the firm. For New York City it was possible to examine the records in more detail, and to make comparisons between contract and inside shops. Workers in New York consistently showed higher earnings and production than those in other centers.

**CHILDREN'S BUREAU, U. S. DEPARTMENT OF LABOR.**—*Child Labor in the Production of Sugar Beets:* Field work has been completed and tabulation of findings is under way in the study of child welfare among sugar-beet

laborers' families undertaken last fall by the Children's Bureau in the sugar beet growing areas of Colorado, Michigan, Minnesota, Montana, Nebraska, and Wyoming. With the cooperation of both producers and laborers, nearly 1,000 families were interviewed. These families included more than 2,200 children 6 and under 16 years of age. The study gives some concrete evidence of the effectiveness of the AAA sugar beet production control contracts providing that no child under 14 years of age should be employed in beet-field labor and that children between 14 and 16 years of age should not be permitted to work longer than 8 hours a day. In 1934, before such control became effective, more than one of every four children between 6 and 12 years of age, or 28 per cent, was reported to have been employed at beet work in the families included in the study. In 1935 only 9 per cent of the children of this age group were reported as working. For the 12- and 13-year-old group the proportion employed dropped from 84 per cent in 1934 to 51 per cent in 1935, a reduction of a little more than one-third. Many of the growers interviewed expressed the belief that employment of older workers was preferable not only for the protection of children but in the interests of efficiency.

*Monthly Reporting of Employment Certificates Issued to Children:* During the 15 years since 1921 a steadily increasing number of state and city officers issuing employment certificates to children of legal working age have been reporting annually to the Children's Bureau the number of first working papers issued to such children. The Bureau has now secured the cooperation of practically all of these officials in reporting the issuance of employment certificates on a monthly basis. For the period from May 28, to December 31, 1935, reports were received from 12 states and 107 cities, 750,000 or more population, in other states. Tabulation of these reports indicated that in the seven months following the decision of the Supreme Court in the Schechter case, bringing to an end the operation of the NRA codes, the number of 14 and 15 year old children going to work in these states and cities was 55 per cent greater than in the entire 12 months of 1934. The collection of statistics on a monthly basis will, it is hoped, help to show whether children receiving certificates upon the closing of school in the spring are employed for the vacation period only or whether they have permanently left school for work.

*Study of Industrial Homework:* Field work has been completed in a study of industrial homework undertaken in 1935 by the Children's Bureau and the Women's Bureau with a view to ascertaining how successfully workers and employers had become adjusted to the abolition of homework during the NRA and whether they had returned to homework following the end of NRA. The industries covered were men's clothing, tags, men's neckwear, medium- and low-priced jewelry, and artificial flowers. Five hundred home workers were interviewed and 125 employers were visited in the course of the study. Tabulation of findings is now under way. The study indicates that the men's clothing industry and the tag industry had so adjusted and re-organized their work that up to that time there had been no return to the



homework system, but that in the other three industries home workers are again being employed.

**U. S. PUBLIC HEALTH SERVICE.**—Research activities of the United States Public Health Service are being expanded under the provisions of the new Social Security Act. Among projects now in progress (aside from purely laboratory studies) may be mentioned the following, all of which utilize statistical procedures.

*Child Hygiene* (Growth and health of school children, nutritional indexes; current obstetric practice; hearing of school children, etc.)

*Dental Studies* (Chronic endemic dental fluorosis or mottled enamel.)

*Dermatosis* (Occurrence of industrial dermatosis, outbreaks among users of manufactured products.)

*Epidemiological* (Special studies as need arises; chiefly concerned now with acute infections of nervous system, especially poliomyelitis.)

*Health Inventory*<sup>1</sup> (The field aspects of this study, referred to in preceding numbers of this JOURNAL, have now been completed. The data are being tabulated.)

*Heart Disease* (Epidemiological studies of rheumatic heart disease.)

*Industrial Hygiene* (Lead poisoning in storage battery industry; effect of silicate minerals; silicosis; studies of industrial morbidity and mortality statistics.)

*Leprosy* (Epidemiology of the disease.)

*Malaria* (Search for new methods of controlling the disease; drainage, ditch maintenance, etc.)

*Milk* (Municipal milk control survey; advisory assistance to state health departments.)

*Public Health Methods* (Job analysis of county health departments; co-operative studies with other agencies; etc.)

*Statistical Investigations* (Prevalence of illness in typical urban and rural communities; recurrent visits to families with chronic diseases; technical supervision of house-to-house canvass, Health Inventory.)

*Tick-borne Diseases* (Their epidemiology.)

*Tuberculosis* (Epidemiological studies of the disease in certain regions showing low and high mortality rates.)

**OFFICE OF EDUCATION.**—*Biennial Survey of Education, 1934-36.* Now that the 1935-36 school year is over, the biennial report forms have been sent to the cities and colleges and are being returned. A preliminary study of income and expenditure data for State degree-granting universities and colleges and about 100 private institutions and the usual Land-grant college preliminary are planned for release in November.

The September issue of *School Life* will have an article on School Survival Rates for the high school classes graduating from 1931 to 1934, and the college classes of 1918, 1932, 1933 and 1934.

<sup>1</sup> Special allotment from Works Progress Administration.

The National Visual Instruction Survey is nearing completion, and the three W. P. A. research projects sponsored by this office, University Research Project, National Survey of Vocational Education and Guidance of Negroes, and the Study of Local School Units, are getting materials in the States which will be coordinated through this office.

**NATIONAL RESOURCES COMMITTEE.—State Section.** In the last three years, State Planning Boards have been established and now exist in all of the 48 states except Georgia and Delaware. Of that number, 32 are on a permanent statutory basis, and the remainder are set up by gubernatorial appointment. Upon meeting certain conditions, the National Resources Committee furnishes to the State Planning Boards the services of a technical Consultant. Research and clerical staff is provided by the Works Progress Administration, by state appropriations and by loans from state departments.

The purpose of State Planning Boards is threefold: (1) inventory of natural and human resources; (2) formulation of master plan for their conservation, utilization, and development; (3) assistance to state government in correlating similar activities of local, state, regional and Federal agencies. Major emphasis in most states is, roughly in order of importance, upon the following: land and water use problems, public works programming, integration of transportation systems, population trends, city and county planning, housing, educational facilities, capacity to produce and consume, recreation, etc. Owing to the lack of funds for printing, copies of several of the State planning reports are not easily obtainable except on loan from the National Resources Committee's Library or from the individual State Planning Boards.

At the suggestion of the National Resources Committee, many State Planning Boards have organized statistical committees to assist in coordinating the Boards' statistical activity with that of other state, Federal and local governmental agencies. Each Board also has a varying number of technical committees representing state departments, universities, civic bodies, prominent citizens, and Federal agencies. Most reports, accordingly, represent the coordinated effort of these different groups.

**Water Resources Committee.** The Sub-committee on Small Water Storage Projects is initiating a review of unpublished hydrologic data in the files of Federal, state, and local agencies. This work will result in the preparation of an index of available unpublished hydrologic data (precipitation, snow survey, ground-water level, stream-flow evaporation, chemical quality of water, suspended matter in water). The index will indicate the location of the data, their duration and their estimated reliability. At present there are large amounts of data in the files of public agencies which are not readily available to hydrologists, engineers and other technicians wishing to use the data for the design of water conservation structures.

The Advisory Committee on Hydrologic Data has recently completed a report on "Deficiencies in Basic Hydrologic Data." The report reviews the adequacy and inadequacy of established facilities for the collection of hydro-

logic data and recommends specific programs for correction of the more serious deficiencies. It contains also the first complete inventory of these data-collecting facilities maintained wholly or in part by the Federal Government. Tables and maps show the location of an administrative responsibility for the maintenance of rain gages, snow surveys, observation wells, stream gages, evaporation pans, and quality of water sampling stations.

*Committee on Urbanism.* One part of the statistical activities of the Research Committee on Urbanism has been devoted to trying: (1) To analyze the social problems of cities by the types of cities, the ages of the cities, and the character of their governments, and by various other general characteristics. (2) To tabulate the incidence of certain problems such as unemployment, dependency, and insanity in order to compare the cities with a high incidence of such problems to cities of median and low incidence. This comparison will be directed toward an understanding of the concomitant phenomena.

In order to make this study, it was necessary to divide the work into several sections. Attempts have then been made to follow a uniform classification of the data to permit comparisons. A card was prepared for each city under each item of the classification. The cards were classified by states and census regions to indicate: (1) The population in 1910, 1920, and 1930. (2) The particular size group to which the city belonged in 1930. The size groups used are those established for urban areas by the U. S. Census. (3) How long the city has been in existence as a city, grouped by the age of the city according to whether the city was "old," "average," or "recent." (4) The percentage rate of population growth from 1920 to 1930. (5) The percentage rate of population growth from 1900 to 1930. (6) The metropolitan region, if any, to which the city belongs. (7) The age composition of the population. Three groups were used: all persons under 20 years of age; persons from 20 to 45 years of age; and all persons 45 years and older. (8) The sex ratio of the population, that is, the number of males per 100 females. (9) The nativity of the population by percentage of native born irrespective of race or color. (10) The racial characteristics of the population expressed as a percentage of the white population to the total population in 1930. (11) The percentage of the population gainfully employed in manufacturing industries. (12) The type of government in the city. (13) Unique characteristics of each city.

It is expected these data will be mapped upon a regional basis to make visual the problems presented. Studies are being made of social problems in cities and of organized groups and activities in urban life such as lodges, associations, and credit unions. These data are being collected by states. Other sections of this part of the study deal with the rural free delivery, telegraph and telephone communication, daily newspapers and periodicals, motion pictures, radio, etc. Still other parts deal with the problems of health, crime, recreation, etc.

It is expected that the statistical data upon all these subjects will be arrayed and studies made of the high, median, and low groups. If time is

available, individual cities which present unusual problems, or combinations of problems, will be singled out for separate study.

**DIVISION OF PLACEMENT AND UNEMPLOYMENT INSURANCE, NEW YORK STATE DEPARTMENT OF LABOR.**—A Division of Placement and Unemployment Insurance has been created in the New York State Department of Labor. This new Division has absorbed the existing State Employment Service which will be expanded to provide the basis for the field service of the merged organization. With reference to its placement activities the new Division is affiliated with the U. S. Employment Service. The Unemployment Insurance Law has been approved by the Social Security Board.

The statistical work of the new Division is a joint responsibility of the Bureau of Research and Statistics and the Bureau of Insurance Control. Current reports from employers and operating reports from the employment offices are received and tabulated by the Bureau of Insurance Control, in accordance with plans and procedures developed jointly by the two Bureaus. The rough tabulations, when completed, will be submitted to the Bureau of Research and Statistics which will prepare final releases for internal use or for publication, and which will be responsible for interpretations and analyses.

The statistical materials of the Division will comprise the payroll and employment statistics derived from employer reports, other records relating to unemployment insurance, and the current reports of placement activities. In addition to the Division's internal statistics, the research staff will of course utilize statistical data from other sources, in measuring trends of employment and unemployment, in forecasting the probable burden on the insurance fund, and in special studies required for the administration of the Law.

The Labor Law of New York State vests responsibility for the administration of unemployment insurance and the conduct of the employment services in the Industrial Commissioner of New York State, Elmer F. Andrews. Glenn A. Bowers, formerly Director of Research of the Industrial Relations Counselors, Inc., has been appointed Executive Director of the Division of Placement and Unemployment Insurance. Harry K. Herwitz, formerly executive officer of the Men's Clothing Code Authority, National Recovery Administration, has been appointed Director of Insurance Control in the Division.

*Bureau of Research and Statistics:* Meredith B. Givens, until recently secretary to the Committee on Industry and Trade, Social Science Research Council, has been appointed Director of Research and Statistics with the Division. From July, 1933, to January, 1936, Dr. Givens was a member of the Central Statistical Board, and served as executive secretary of the Committee on Government Statistics and Information Services sponsored by the American Statistical Association and the Social Science Research Council. Under his direction the staff of the Bureau of Research and Statistics is being recruited under State Civil Service regulations, to meet the needs of expanding work.

The Bureau of Research and Statistics is located at the metropolitan office of the Division, at 342 Madison Avenue, New York City. The statistical records are located partly at the metropolitan office and partly at the headquarters office in Albany.

An early major task of the Bureau has been the preparation of an *industrial classification plan* to be applied in connection with the assignment of employers' registration numbers. This work has been done in consultation and in full cooperation with the several interested bureaus of the Social Security Board, the U. S. Bureau of Labor Statistics, the Central Statistical Board, the Committee on Economic Security of the Social Science Research Council, and other agencies. The plan provides for the identification of a limited number of major industry groups by means of two digits in the employers' registration number, more detailed statistical groupings to be provided within the office. Preliminary classification indexes covering more than 8,000 industry designations have been prepared by means of experimental classification of a large number of employer returns. The employer returns have now been coded in accordance with this classification plan. This procedure, and other phases of procedure as they develop, will be reduced to manual form by the Division.

An elaborate *Economic Brief* was prepared by the Bureau, in connection with the defense of the Unemployment Insurance Law in the New York State courts.

A *research library* and a *statistical laboratory* have been initiated in conjunction with the work of the Division, and files of basic statistical data obtainable from other agencies are being assembled.

The Bureau has had invaluable assistance from Dr. C. A. Kulp and Dr. Leonard Adams of the Committee on Economic Security of the Social Science Research Council, whose services have been loaned during the preliminary period of work, specifically in connection with the preparation of the *Economic Brief* in support of the Unemployment Insurance Law, and in the experimental work on industrial classification.

**DOMINION BUREAU OF STATISTICS, CANADA.—1936 Census of the Prairie Provinces.**—The Quinquennial Census of the Prairie Provinces of Canada taken, by statute, five years after each decennial census was taken on June 1st, 1936. Early returns have been received, and it is expected that all census returns will be in by July 15th. A preliminary report on the population is expected to be ready by August 1st.

**Reports.** The Report on the Conference on Agricultural Statistics, held in the Dominion Bureau of Statistics on March 30–31 and April 1–2, and attended by Dominion and Provincial Government Officials and representatives from many parts of Canada and from the United States, has recently been published by the Agricultural Branch. This was the first conference of its kind held since 1924 and covered the whole range of agricultural statistics and their presentation.

NATIONAL BUREAU OF ECONOMIC RESEARCH.—Dr. Joseph H. Willits, a member of the Board of Directors since 1927 and its present Chairman, has accepted the position of Executive Director of the National Bureau. In so doing, Dr. Willits continues to serve as Dean of the Wharton School of Finance and Commerce at the University of Pennsylvania, spending part of his time at the National Bureau. The office of Executive Director is a newly created one, and Dr. Willits will be active in furthering the program of co-operative research initiated by the National Bureau last year. As a center for this program, 'Hillside,' a property in Riverdale-on-Hudson to which the National Bureau has acquired title, will be used.

Two publications of the National Bureau appeared during the summer. *Ebb and Flow in Trade Unionism*, by Leo Wolman, presents recent figures on membership in trade unions, in part the result of special compilations. Dr. Wolman traces the major changes in the extent of labor unionism since his preceding volume on the subject, *Growth of American Trade Unions, 1880-1923*, and gives an analysis of its present status.

Also published was *Bulletin 60*: "Measures of Capital Consumption, 1919-1933," by Solomon Fabricant, an interim report of the study of consumption of capital since the War. It is restricted to the consumption of business capital and presents annual measures, corrected and uncorrected for price changes. *Bulletin 61*, "Production during the American Business Cycle of 1927-1933," by W. C. Mitchell and A. F. Burns, is in press.

Those interested in Dr. Mitchell's second volume—*Business Cycles: Analysis of Cyclical Behavior*—will be glad to learn that mimeographed copies of the third chapter are now available on special order.

Manuscripts of two forthcoming books are in the hands of the printer: Dr. Macaulay's *Some Theoretical Problems Suggested by the Movements of Interest Rates, Bond Yields, and Stock Prices in the United States Since 1857*, and Dr. Mills' study of prices and the price system during recession and recovery. Dr. Mills considers his report more in the nature of a monograph which contributes to an understanding of recent economic movements than as a definitive study of the behavior of prices during the depression and recovery. He follows out certain of the analyses begun in *Economic Tendencies* and carried forward in briefer form in several *Bulletins* issued in the interval.

WHARTON SCHOOL OF FINANCE AND COMMERCE, UNIVERSITY OF PENNSYLVANIA.—The Industrial Research Department is cooperating with the National Research Project of the Works Progress Administration under the direction of Mr. David Weintraub in the making of the annual spring survey of employment and unemployment in Philadelphia. Dr. Gladys L. Palmer of the Industrial Research Department is in charge of the survey and also of the study of job openings and applicants at the Philadelphia State Employment Office. The latter study is a continuation of a series conducted by Dr. Palmer since 1931. These studies constitute part of a general survey

of recent trends in the Philadelphia labor market. The field work will be completed by the end of the summer and the reports published next spring.

The Industrial Research Department of the Wharton School of the University of Pennsylvania has been appointed as the research agency to conduct the study of "Production and Distribution in the Textile Industry," the financing of which was recently authorized by the Textile Foundation. The work will be done in cooperation with the committee on Economic Research of the United States Institute for Textile Research and an auxiliary committee composed of presidents of several of the major textile associations. Joseph H. Willits, Dean of the Wharton School, will be in general charge of the study and will be assisted by the following members of the Industrial Research Department:—C. C. Balderston, Professor of Industrial Management, Anne Bezanson, co-director of the Department, H. S. Davis, in charge of the wool section, and George W. Taylor, in charge of the hosiery section. Mr. Davis will serve as secretary of the group. Other members of the Department and of the School will be called upon to participate in particular phases of the study.

Mr. H. S. Davis, in charge of research in the wool textile industries for the Industrial Research Department has been cooperating with the Bureau of the Census in revising their monthly reports on raw wool consumption, and wool machinery activity.

**NATIONAL INDUSTRIAL CONFERENCE BOARD.**—The National Industrial Conference Board has in preparation a study of *Private Long-Term Debt in the United States* and a volume on *Wages in the United States, 1914-35*, which will parallel a volume on the cost of living now in press. The volume on wages will assemble in one place the results of the Board's inquiries during 1935 and will give a complete statement of all of its inquiries since they were initiated in 1920 including comparisons in 1914.

The following publications are in press and will be issued soon:

*International Transactions of the United States.* An exhaustive analysis of the procedure followed in computing the balance of international payments. An examination of existing figures and the presentation of a new estimate of the varied elements that enter into the balance of international payments.

*National Income and Its Elements.* A comprehensive study of the problems of estimating the national income and the presentation of the results of the Board's study of national income in the years 1929 to 1934.

*Savings Plans and Credit Unions in Industry.* A study based on a consideration of general practice and the result of an extensive questionnaire inquiry.

*The Cost of Living in the United States, 1914-35.* This volume will contain, besides the figures for 1935 not heretofore published in book form, a complete statement of the results of the inquiries that have been conducted by the Board over a number of years into the cost of living.

The following studies have been issued by the National Industrial Conference Board between January 1 and July 1, 1936:

219. *The Townsend Scheme*. An analysis of what the plan proposes, how it is expected to operate, and a study of the probable economic effects of the scheme.
220. *Women Workers and the Labor Supply*. A statistical analysis of data regarding women in occupations, derived mainly from the census records, together with a discussion of the available data regarding the apparent effects of the depression on the employment of men and women, respectively.
221. *What Employers Are Doing for Employees*. A study, on the basis of a questionnaire widely distributed by the Board, of the prevalence of the various types of advantages offered to employees that are comprised under the general head of industrial relations activities.
222. *A Statistical Survey of Public Opinion Regarding Current Economic and Social Problems as Reported by Newspaper Editors in the First Quarter of 1936*. A tabulation of returns received by the Conference Board from 3,685 newspapers and farm journals in the United States, representing a total circulation of 17,544,500. Some thirty or more distinctive economic and social problems were submitted to these editors, who were requested to state whether the prevailing opinion in their localities favored or disapproved each specific measure.
223. *Cost of Government in the United States, 1933-35*. A continuation of the previous studies of the Board on the cost of government. These publications have had wide acceptance through the fact that the data and estimates given relate, not to the Federal Government only, but to all governments in the United States including state and local governments. The greater part of the general data on expenditures, tax collections, and debt give figures separately for Federal, for state, and for local governments.
224. *American Agricultural Conditions and Remedies: A Preliminary Survey*. A brief analysis of agricultural conditions in four chapters: I. The American Agricultural Picture today; II. The Measurement of Agricultural Conditions; III. Past Attempts to Help Agriculture; and IV. Positive Programs for Agricultural Improvement.

INSTITUTE OF MATHEMATICAL STATISTICS.—Professor R. A. Fisher of the University of London is among the scholars whom Harvard University is inviting as lecturers in connection with its Tercentenary. Professor Fisher will give a "Harvard Tercentenary Conference Lecture" on the subject: "Uncertain Inference," before a joint session of the American Mathematical Society, Mathematical Association of America, and the Institute of Mathematical Statistics on August 31.

DR. OTTO NEURATH, economist, of Vienna, whose work in the visual portrayal of statistical data has attracted much attention in this country,



will spend three or four months in the United States in the autumn. He will come as the guest of a hospitality committee of which Dr. Alvin Johnson, Director of the New School for Social Research, is chairman. Several organizations are joining in preparations for his visit, including the Oberlaender Trust, the National Tuberculosis Association, the Vocational Adjustment Bureau for Girls, the International Industrial Relations Institute, and Pictorial Statistics, Inc. The purpose of Dr. Neurath's visit will be to make a study of the potentialities in the development of visual education in this country. Plans are also being considered for him to give special instruction of a technical character to those interested in studying what has come to be known as the Vienna method of statistical visualization. The International Foundation for Visual Education, of which Dr. Neurath is Director, and which has its headquarters at The Hague, provides the auspices for this work in several countries. The Institute's forwarding address in the United States is in care of the International Industrial Relations Institute, Room 600, 130 East 22nd Street, New York.

## MALCOLM CHURCHILL RORTY

COLONEL MALCOLM CHURCHILL RORTY, former President of the American Statistical Association and for many years a dynamic and influential leader in its activities, died of a heart attack on January 18, 1936.

Colonel Rorty was born in Paterson, N. J., in 1875. He attended Walkill Academy, Middletown, N. Y., and was graduated from Cornell University in 1896 with degrees in mechanical and electrical engineering. Entering the employ of the New York Telephone Company shortly thereafter as a telephone installer, he began a career in the various companies of the Bell System which continued over a period of 27 years.

Granted a leave of absence for military service when America entered the World War, Mr. Rorty was assigned to the Interallied Munitions Council with the task of directing the procurement and shipment of ammunition. Later, as an officer of the General Staff, he took part in active service in the Meuse-Argonne offensive retiring at the close of the war with the rank of Lieutenant Colonel.

Upon his return to civil life in 1918, Colonel Rorty was appointed Chief Statistician of the American Telephone and Telegraph Company. Three years later he was made Vice President of the Bell Telephone Securities Company, returning the following year to the American Telephone and Telegraph Company as Assistant Vice President. In 1924 he resigned from the Bell organization to accept appointment as Vice President of the International Telephone and Telegraph Corporation, which position he held until he became Vice President of the American Founders Corporation in 1930.

Despite Colonel Rorty's announced retirement from active business life in 1931, demands for his services as an industrial and economic expert continued during the depression years and he was summoned as a consultant in many problems of financial reorganization. In May, 1934, he was elected President of the American Management Association and served illustriously in that capacity until his death.

Possessed of boundless energy, a wide range of knowledge, an imagination of rare breadth, and a readiness to subject his hypotheses to the most rigorous tests, Colonel Rorty left a deep impress upon every organization and activity with which he came in contact. His flair for the scientific method is manifested by his having written, early in his telephone experience, a mathematical treatise on "The Application of the Theory of Probability to Traffic Problems," regarded by Bell System engineers as the pioneer contribution to this field. With the later extension of his interests into broader fields of industrial operation and financial policy, his work continued to be characterized by great zeal for sound methodology and an adequate factual

In 1917, Colonel Rorty became a member of the American Statistical Association and two years later, as Chairman of the Committee on Business Statistics, began his noteworthy efforts to promote interest on the part of

business executives and trade association authorities in the more extensive compilation and prompt publication of statistics of physical production in the manufacturing industries. This work bore immediate fruit, not only in increasing the volume of data available for economic analysis, but also in vastly broadening the interests of the Association itself and aiding to bring within its membership the leaders of the then relatively new and rapidly expanding profession of business statistician.

In 1921, Colonel Rorty was elected a Fellow, and in 1922 a Vice President, of the Association. His vision and inspiring leadership played an important part in the founding of the National Bureau of Economic Research in 1924, and from that date continuously until his death he was a member of the Board of Directors of the Bureau by appointment from the Association, serving also from time to time as its treasurer, president and chairman of the board. In recognition of his contributions to the field of statistics and economic research, the American Statistical Association elected him as President for the year 1930. His administration was marked by substantial progress, not only in the scope and content of its annual and regional meetings, but also in membership growth and the strengthening of its internal organization. Subsequently he served for two years as a member of the Board of Directors and for two years as a member of the Finance Committee. At the time of his death he was a member of the Committee on Fellows.

In the field of published material, Colonel Rorty was perhaps best known for the pungent and thought-provoking notes which he contributed at frequent intervals to this JOURNAL and other periodicals. Among his longer contributions may be mentioned a book on "Some Problems in Current Economics," published in 1922; a paper on "The Necessity for Wage Reductions in the Present Crisis," published in the *Proceedings of the Academy of Political Science* (1932); and the following three papers which appeared in the *Harvard Business Review*: "The Statistical Control of Business Activities," (1923); "How May Business Revival be Forced," (1932); and "The Equation of Economic Balance," (1934).

Warm hearted and sympathetic in his human relations, eager in his loyalties, always stimulating and often provocative in his arguments, Colonel Rorty had a genius for making friendships that will long be treasured by those who knew him best. As a statistical worker, his philosophy and habits of thought are perhaps best portrayed in his Presidential Address at the ninety-second annual meeting of the Association, published in the March, 1931, issue of this JOURNAL. The concluding sentences of this address are particularly self-revealing:

The statistician, as the chief pathfinder among scientific pioneers, must necessarily combine that vision which comes from fertility, breadth, and incisiveness of hypothesis, with the balance and sureness of step of the scientific method as a whole. But, above all, he must possess something of the rude spirit of the frontiersman and must seek his results in every legitimate way, regardless of refinements of method and rigidity of conventions.

DONALD R. BELCHER

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## REVIEWS

*Length of Life*, A Study of the Life Table, by Louis I. Dublin and Alfred J. Lotka. New York: The Ronald Press. 1936. xxii, 400 pp. \$5.00.

Once more Dr. Dublin and Dr. Lotka have put the statistical world in their considerable debt, for the present work is a valuable and useful addition to the available literature on human life duration. It will prove useful both for reference and for teaching. The typographical arrangement of the book suggests that the latter objective was definitely and purposefully in the minds of the writers, as does also the evident pains taken to explain with the utmost clarity and simplicity the various technical steps taken in the development of their argument and of their material. As was to be expected from such accomplished literary technicians, the whole book is a model of lucid exposition of an inherently complicated and difficult subject.

The book is developed around the life table, as the subtitle implies. A few pages of general introductory matter about human longevity in general include an account of Christen Jacobsen Drakenberg, a Danish sea-faring man reputed to have lived just a few days short of 146 years, in the 17th and 18th centuries. That was a long time ago—as a current ribald drinking song so effectively emphasizes—and at least one hardened sceptic ventures to doubt the alleged record, even though the authors seem disposed to regard it indulgently because it has been seriously discussed in the highest-toned of actuarial journals.

After the brief introduction the authors present two new life tables that they have computed (one for males and the other for females) to represent the mortality conditions prevailing in the United States, excluding Texas and North Dakota which were not in the Registration Area in 1929, over the three-year period 1929–1931 centering about the date of the last census. The meaning and mode of derivation of each item in these life tables are discussed in detail and with exemplary clarity. In fact I do not know of any place in the literature where the detailed anatomy of a life table is so beautifully and adequately described. The only possible criticism that could be offered is that in this chapter of the book, in direct connection with the informing of the reader of the nature of life tables derived from general population data, it might have been desirable if the authors had devoted a separate section to an equally clear exposition of the peculiarities and limitations of life tables derived from other sorts of data, such as life insurance experience, the complete following through of each individual life from birth to death which is possible with lower organisms, etc. In this way it would have been possible to make it perhaps clearer just what postulates and assumptions are implicit in the general population type of life table compared with other types. To be sure, there is a chapter towards the end of the book on insurance life tables, but even that does not seem to bring out the point under discussion with quite the clarity and emphasis that might be desired.

But, after all, this is a sin of omission only, if a sin at all, and no great weight is to be attached to it.

The next chapter deals with the life table as a record of human progress and reaches the conclusion that there was a gain of 10 or more years in average length of life in the more progressive countries during the 19th century, and that this was not due to any significant change in the inborn characteristics of the human material itself but rather to more civilized living and better knowledge of methods of controlling disease. To the gains in life expectation of the population of the United States a separate chapter is devoted. The results are gratifying but not in principle different from those already noted.

A chapter on geographic distribution of longevity in the United States discusses penetratingly the question of comparative urban and rural mortality rates and presents a particularly striking table in which death rates attributed to cancer on the one hand, and to senility, ill-defined and unknown causes combined on the other, are presented in parallel columns by state, indicating some part of the considerable effect that faulty registration practice may have upon apparent urban-rural differences. There then follow three chapters on various biological aspects of the life table, the first two making a valuable analysis of the mortality curve into components attributable to particular causes and groups of causes, and the third reviewing the present status of knowledge regarding the inheritance of longevity. The increase of mortality from heart diseases in 1930 over 1920 is attributed in part to greater survivorship from other hazards of earlier life. A long chapter on the contribution of medical and sanitary science to longevity ends with a hypothetical life table that speculatively predicts what further progress in life expectation may be attainable. It puts the expectation at birth at approximately 70 years. The assumptions made in the construction certainly do not seem unreasonable, and there is none of the silly nonsense, that some less acute writers have indulged in, about a prospective lengthening of the life span.

Physical impairments and occupation in relation to longevity are discussed in the next two chapters, mainly by way of review. A long and superb chapter on the life table in relation to population problems is an outstanding feature of the book. It is based upon and in part embodies some of the highly original and epoch-marking investigations of the junior author in particular in the field of population theory. The remainder of the volume is devoted to matters of special interest to those working in the field of life insurance and to detailed instructions for the computation of a life table from population data.

Altogether this is a notable contribution that no human biologist, statistician, actuary, or public health worker will fail to read and preserve on his library shelves.

RAYMOND PEARL

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*Family Expenditure: A Study of its Variation,\** by R. G. D. Allen and A. L. Bowley. London: P. S. King and Son, Ltd. 1935. viii, 145 pp. 9 s.

This study of variations in family expenditures presents an interesting and valuable example of the possibilities of mathematical analysis in the field of consumption. The volume is divided into four quite distinct sections. The first chapter analyzes data from 21 different studies of family expenditures with techniques made familiar in this country by W. F. Ogburn in his analyses of data collected by the U. S. Department of Labor in the District of Columbia in 1916 and in 91 different cities in 1917-19.<sup>1</sup>

The second chapter presents an original contribution to the techniques of measuring variations in family expenditures by analyzing the differences between the actual expenditures of individual families and the expenditures which would be expected on the basis of regression equations expressing the average behavior of their group. The third chapter is devoted to a theoretical analysis of the distribution of expenditure which develops theses, presented by one of the authors with Mr. J. R. Hicks in *Economica*.<sup>2</sup> The fourth section, the appendix, sets forth the mathematical basis for the third chapter. The third and fourth sections, which represent about one-third of the volume, build upon the work of Edgeworth and Pareto and seek to develop theories of the marginal rate of substitution for competitive consumers' goods.

The volume is somewhat marred by the looseness with which it uses certain economic terms. For example, the term "total income" is not infrequently used interchangeably with "total family expenditures for consumer goods and services," whether paid for out of current income, from savings, or from borrowings. References in the text to data for New York state farm families, supplied by Canon (p. 79), would lead one to believe that figures on the food expenditures of these families might include money value of food produced by these families for their own consumption, but there is nothing in either text or tables to explain how home-produced food has been treated. The authors follow the continental usage and restrict the term "workers" to wage earners, "workers" being contrasted with "salaried employees" and "officials," an unsound, if not a dangerous distinction.

In the first chapter of the book, the authors use the results of 19 studies made in Europe from 1904 to 1932 and of two made in the United States, the 1917-19 study of the United States Department of Labor and that made by Canon among the central New York farm families in 1928-29. Their first

\* *Review Editor's note:* Because of the nature and importance of this book, reviews from two points of view were arranged for.

<sup>1</sup> Ogburn, William F., "Analysis of the Standard of Living in the District of Columbia," *Quarterly Publications of the American Statistical Association*, vol. 16, 1919, pp. 374-389.

Ogburn, William F., "A Study of Food Costs in Various Cities," U. S. Department of Labor, Bureau of Labor Statistics, *Monthly Labor Review*, vol. 9, no. 2, 1919, pp. 1-25.

Ogburn, William F., "A Study of Rents in Various Cities," U. S. Department of Labor, Bureau of Labor Statistics, *Monthly Labor Review*, vol. 9, no. 3, 1919, pp. 9-30.

Ogburn, William F., "The Financial Cost of Rearing a Child," U. S. Department of Labor, Children's Bureau, *Standards of Child Welfare*, pp. 28-30. 1919.

<sup>2</sup> Hicks, J. R. and Allen, R. G. D., "A Reconsideration of the Theory of Value." *Economica*, n.s. 1. pp. 62-76, 196-219. London, 1934.

purpose is to discover whether family expenditures on various items bear linear or other relations to total expenditures. An analysis of average expenditures for groups of items, shown by these 21 studies, leads them to conclude that there is "a good fit, allowance being made for observation and sampling errors and for imperfections in the data, to a linear expenditure relation, and occasionally to a parabolic relation" (p. 123). They point out, however, that the linear law is only a first approximation and that it is only a close fit over the central range of incomes and may easily cease to apply at low or high incomes (p. 14). This chapter includes a discussion of index numbers of living costs, emphasizing the fact that "an index of the cost of living based on average expenditure is only applicable to families whose expenditure is near the average." The authors illustrate the familiar fact that the level of an index number depends on the relative weights given to its component sub-indexes for food, rent, fuel, light, and so on, as well as on the level of the sub-indexes. With the use of indexes computed by the British Ministry of Labour on the average cost in January, 1935 (base July, 1914) of the various *groups* of items purchased by British wage earners, and regression equations based on a study of wage earners' expenditures, they show how new indexes of living costs may be computed for any income level higher or lower than the average. The indexes thus calculated are 129 for the low expenditure family and 150 for the high expenditure family. They may be compared with 143 for the average family, as computed by the Ministry of Labour (p. 17). The authors point out that "These results would, of course, be somewhat modified if the computation was carried out in full detail." The difference between the indexes computed for the low expenditure family and the high expenditure family, 16 per cent, is very much greater than those secured in the United States by the Department of Labor, and by the Heller Committee for Research in Social Economics in computing similar indexes although with a narrower expenditure range. The BLS index<sup>3</sup> of living costs of custodial employees living in Washington with basic salaries under \$2,500 (average total expenditures \$1,989) for November, 1934, was 85.6 in comparison with 100 for the first six months of 1928; for employees with basic salaries over \$2,500 (average total expenditures \$4,114), the index was 87.3, a difference of 2 per cent. The Heller Committee<sup>4</sup> index for wage earners in San Francisco was 81.9 for November, 1935, in comparison with 100 in 1929 (average expenditures \$2,379) and for executives, 83.9 (average expenditures \$7,179), a difference of 2.4 per cent.

The relatively large differences in the index numbers for workers with expenditures of one-half the average expenditure and twice the average expenditure ( $\frac{1}{2}$  and  $2\frac{1}{2}$ ), computed by Allen and Bowley, may be explained by a number of different factors. The group indexes used in their computations

<sup>3</sup> United States Department of Labor, Bureau of Labor Statistics. "Cost of Living in the United States and Foreign Countries," *Monthly Labor Review*, vol. 40, no. 2, Feb. 1935, p. 531.

<sup>4</sup> Heller Committee for Research in Social Economics. *Quantity and Cost Budgets for (1) Family of an Executive, (2) Family of a Clerk, (3) Family of a Wage Earner, (4) Dependent Families or Children, Prices for San Francisco*, November, 1935, University of California, Berkeley, California, February, 1936.

represent changes in costs in Great Britain from July, 1914, to November, 1935, and the weights represent British experience in 1904. The regression equations used to compute indexes for families with expenditures of  $\frac{1}{2}\bar{x}$  and  $2\bar{x}$  come from a German study of 1927-28. The authors may be mistaken in assuming that a linear relationship between total expenditures and expenditures for specific items other than food would extend over an income range as wide as  $\frac{1}{2}\bar{x}$  to  $2\bar{x}$ . Reweighting group indexes instead of reweighting price ratios for specific commodities would, as the authors point out, always result in a certain amount of error. In view of the possibilities of the misinterpretation of this section, it is unfortunate that it was not further safeguarded.

The analysis is continued with material from investigations for which the authors had available detailed expenditure figures for each of the families in the groups studied: wage earners in Hamburg and Bremen in 1927-28 and in Liverpool in 1929, clerks in English towns in 1926, families from all classes studied by the London School of Economics in 1932, and the New York state farm families studied by Canon in 1928-29. The data from these investigations are used to measure variations of the expenditures of individual families from the linear relationships discovered to be typical for their group. These experiments provide, in the opinion of the present reviewer, the most valuable section of the book.

The equation of linear relationship is developed with the following symbols:

$$y = k\bar{x} + c$$

in which  $y$  equals the average expenditure of the group for a given item,  $\bar{x}$  the average total expenditure, and  $k$  and  $c$  are constants, determined by the least squares method from the data for the entire group. The difference between the observed expenditures of particular families for given items and groups of items and the expenditures expected from the regression lines expressing the average behavior of the group of which this family is a part are called "residual expenditures." Eliminating the effect of differences in total expenditure for the  $t$ th family

$$y_t = ke_t + c + v_t \quad \text{and} \quad v_t = y_t - (ke + c)$$

where  $e_t$  and  $y_t$  are the total expenditures of the particular family and their expenditure on a given item.

A study of the coefficient of variation of these residual expenditures  $v_t$  and of the distribution about the average (which is necessarily zero) provides a very valuable test of the homogeneity of certain of the expenditure patterns of the groups considered. For example, the distribution of the residuals computed from the expenditures for rent by clerks in English towns in 1926 in relation to their total expenditures is approximately symmetrical in character with a chi square of only 6+, which indicates a very good fit, as it was calculated on the basis of averages from ten groups of cases.

On the other hand, similar figures collected by the London School of Economics in 1932 from families responding to a broadcast appeal for data on their expenditures provide quite different results. "The families were not homogeneous in social class and they came from various parts of the country. The collection can be taken as largely middle-class and professional but a certain number of definitely working-class families are included" (p. 80). The distribution of the residuals from regression lines of expenditure for rent per equivalent adult for this group is very much skewed and indicates (as is natural) that either the housing conditions or the tastes as regards housing (or both) of this group are far from being homogeneous.

The authors conclude their analyses of variation by pointing out that "These particular results can only establish a presumption that the analysis is applicable. More definite conclusions can only be obtained when budget collections are available with a more detailed classification of items, when more attention is paid to variation of needs, and when we have larger and more homogeneous samples of families" (p. 85). The studies of consumer purchases now under way in the United States will provide such data. So, presumably, will the study shortly to be undertaken in this field by the British Ministry of Labour, since Professor Bowley is a member of the advisory committee which is assisting in planning it.

FAITH M. WILLIAMS

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*Family Expenditure: A Study of its Variation*, by R. G. D. Allen and A. L. Bowley. London: P. S. King and Son, Ltd. 1935. viii, 145 pp. 9 s.

This investigation differs from all previous family budget studies in that it is based definitely on some of the preconceptions of modern mathematical theory of utility and exchange. That theory enables us to explain the pattern of consumption of an individual in terms of his tastes, his income, and market prices. Its application to family budget data should yield useful and interesting results.

More specifically, the purposes of this investigation are, in the words of the authors, "... to discover how far the expenditures of individual families or of groups of families can be described by rules and formulae, to relate any rules that are found to the postulates of economic theory and to describe the variations from the averages that result from the different choices of individual families" (p. 1).

The theory is severely mathematical in form and is summarized in a mathematical appendix of nineteen pages. It cannot conveniently be condensed further. All that it is possible to give within the limits of a review are (1) the major steps by which the authors reach their most important formula, and (2) the uses to which this formula is put.

Let there be  $n$  consumers goods,  $X_1, X_2, \dots, X_n$ , and let his tastes be represented by the *function index* of utility

$$(1) \quad u = F\{\phi(X_1, X_2, \dots, X_n)\},$$

where  $\phi$  is any form of the index and  $F$  is an arbitrary function limited only by the condition that  $F'(\phi) > 0$ . Let the goods be obtainable on a given market at the uniform prices  $p_1, p_2, \dots, p_n$ , respectively. At these prices the individual purchases the quantities  $x_1, x_2, \dots, x_n$ , so that his expenditure  $e$ , on any good  $X_r$  is  $e_r = p_r x_r$ , his total expended income being:

$$(2) \quad e = x_1 p_1 + x_2 p_2 + \dots + x_n p_n.$$

The problem is to determine the equilibrium purchases  $x_1, x_2, \dots, x_n$ .

If we assume that within the limits of his income the individual purchases that combination of goods which pleases him most, the solution is obtained by maximizing (1) subject to condition (2). The necessary conditions for this maximum are that

$$(3) \quad du = F'(\phi) \left( \frac{\partial \phi}{\partial x_1} dx_1 + \frac{\partial \phi}{\partial x_2} dx_2 + \dots + \frac{\partial \phi}{\partial x_n} dx_n \right) = 0$$

and

$$(4) \quad de = p_1 dx_1 + p_2 dx_2 + \dots + p_n dx_n = 0,$$

the partial derivatives being functions of all the quantities.

The solution may be put in this form:

$$(5a) \quad \frac{1}{p_1} \frac{\partial \phi}{\partial x_1} = \frac{1}{p_2} \frac{\partial \phi}{\partial x_2} = \dots = \frac{1}{p_n} \frac{\partial \phi}{\partial x_n},$$

which, together with (2) are equal in number to the  $n$  unknown quantities. The economic interpretation of equations (5) is that at equilibrium the marginal utility per "penny's worth" is the same for all commodities.

Equations (5) may also be put in the form:

$$(5b) \quad \frac{\partial \phi / \partial x_1}{\partial \phi / \partial x_n} = \frac{p_1}{p_n}, \quad \frac{\partial \phi / \partial x_2}{\partial \phi / \partial x_n} = \frac{p_2}{p_n} = \dots = \frac{\partial \phi / \partial x_{n-1}}{\partial \phi / \partial x_n} = \frac{p_{n-1}}{p_n}$$

which expresses the fact that at equilibrium the marginal degrees of utility of any two commodities are in the same ratio as their prices. The geometrical interpretation of (5) is that the equilibrium quantities are the coordinates of the point at which the "indifference loci" (3) are tangent to the hyperplane (2); at that point the slopes of the indifference loci and of the hyperplane are equal to one another.

Now the absolute value of the slope of the indifference locus of the goods  $X_r$  and  $X_s$  is, by (3),

$$(6a) \quad - \frac{\partial x_r}{\partial x_s} = \frac{\partial \phi / \partial x_r}{\partial \phi / \partial x_s}, \quad (r, s = 1, 2, \dots, n).$$

Following Hicks and Allen,<sup>1</sup> the authors define (6a) as "the marginal rate of substitution of  $X_r$  for  $X_s$ ," and designate it as

$$(6b) \quad - \frac{\partial x_r}{\partial x_s} = R(x_1, x_2, \dots, x_n).$$

<sup>1</sup> J. R. Hicks and R. G. D. Allen, "A Reconsideration of the Theory of Value," *Economica*, XIV (1934), 52-76 and 196-219.



Solving this set of  $n$  equations for  $e_r$ , the authors obtain the simple linear form:

$$(14) \quad e_r = k_r e + c_r,$$

where  $k_r$  and  $c_r$ , which involve the  $b$ 's, are constant for any individual (or homogeneous group of families), but may differ from individual to individual (or from group to group). If  $k$  and  $c$  differ, the individuals or the groups in question are not alike with respect to their desire for the given good.

Formula (14), which constitutes the keystone of the authors' theoretical structure, enables them to test Engel's Law. This law states that as income increases the proportions spent on the more urgent needs (such as food) decrease whereas those devoted to luxuries or semi-luxuries increase. Denoting by  $f$  the amount spent on any such item as food, the formula becomes:

$$(15) \quad f = ke + c,$$

where  $k$  is the slope and  $c$  is the intercept of the straight line. If  $c > 0$ , the larger its value the more rapidly does the proportion of expenditure on the item in question decrease as total expenditure increases. If  $c < 0$ , the larger its numerical value, the more rapidly does the proportion spent on the item increase with total expenditure. A commodity is defined as a necessity if  $c > 0$  and as a luxury if  $c < 0$ . The order of values of  $c$  from large plus to large negative value thus fixes the *order of urgency* of the items in the budget.<sup>3</sup>

Armed with this tool of analysis, the authors examine twenty-six family budgets relating to different countries with a view of determining whether the average expenditures on the various items satisfy formula (14) or some other simple equation. Then they analyze certain budget collections for which detailed individual returns are available in order to determine the relation of individual to average expenditure as income changes. They find that, when allowance is made for sampling errors and for imperfections in the data, the average expenditures on various items in the family budget are related to the average income by the simple linear equation (14), although occasionally a parabolic relationship is clearly indicated. The data also show that there is a considerable variation of expenditure about the average of each group but that when allowance is made for the variation of needs and income, the deviations of the individual expenditures about the line of regression can be described, at the first approximation, by the normal law.

The names of the authors are a sufficient guarantee of the excellence of the work. In the opinion of the reviewer, however, the investigation would have been enriched by a comparison of their Engel curves with those contained in the pioneering study by Professor W. F. Ogburn, which was based on more than 2,000 budgets of families living in the District of Columbia in 1916.<sup>4</sup> For the two investigations mutually confirm one another. Ogburn

<sup>3</sup> In their statistical work the authors find it convenient to transpose the origin of the variables to their arithmetic means and to divide the result by  $e$ .

<sup>4</sup> W. F. Ogburn, "Analysis of the Standard of Living in the District of Columbia in 1916," *Journal of the American Statistical Association* XVI (1919), 374-389.

Ogburn dealt with 20 variables and gave 37 simple and 18 multiple regressions.

finds that within the observed income ranges the Engel curves are approximately linear; so do Allen and Bowley. Ogburn's regressions show that when allowance is made for the size of the family, the proportions of the total income spent on food, rent, and fuel and light, liquor and tobacco, and sickness decrease as income increases, whereas the proportions spent on clothing, sundries, religion, furniture, education, and amusement increase with income. This conclusion is also in harmony with Allen and Bowley's findings.

The reviewer also wonders whether *as econometricians* the authors have not paid too big a price when they adopted the Hicks and Allen definition of complementarity,<sup>5</sup> for according to that definition two commodities can be related only by way of competitiveness, even though they are salt and soup!<sup>6</sup> He appreciates the authors' desire to build an "objective" theory, i.e., one which does not postulate the measurability of utility. But their theory is valid only for an *individual*. To be able to use it in analyzing statistical data, they are compelled to assume that it is also applicable to a *group* of individuals. Since individual indifference curves cannot be aggregated to form the indifference curve of the group except by postulating a utility function for the group, does not the *statistical procedure* of the authors come dangerously close to implying that utility is not only measurable but that the utilities of different persons are comparable? If this interpretation is correct, it is difficult to justify their rejection of the classical definition that two goods  $X_1$  and  $X_2$  are completing, independent, or competing according as  $\partial^2\phi/\partial x_1\partial x_2$  is positive, zero, or negative, on the ground that this definition assumes utility is measurable in the sense that the index of utility  $F$  is a linear function of  $\phi$ :  $F = A + B\phi$ . But since the authors do not apply their definitions of complementarity, this point is not of immediate importance.

*Family Expenditure* is an important contribution to econometrics. It may very well be that sociologists, psychologists, advertisers, and others who are interested in consumer behavior will have to turn to mathematical economics if they are to understand future researches in this field.

HENRY SCHULTZ

University of Chicago

*Studies of Family Living in the United States and Other Countries: An Analysis of Material and Method*, by Faith M. Williams and Carle C. Zimmerman. Washington, D. C. United States Department of Agriculture, Miscellaneous Publication No. 223. 1935. 617 pp. 60 cents.

A comprehensive survey of family living studies has been needed urgently for many years, and this report will be useful to students in a wide variety of

<sup>5</sup> See reference in note 1.

<sup>6</sup> For a comparison of different definitions of completing, independent, and competing goods, see Henry Schultz, "Interrelations of Demand, Price, and Income," *Journal of Political Economy*, XLIII No. 4, especially pp. 458-63.



fields. Approximately 1,500 studies in 52 countries have been listed, and a short resumé usually running between 100 and 500 words each is given for nearly all the studies. The summaries of the foreign studies are especially valuable, since they bring information of at least a partial character on a field largely inaccessible to the majority of students in this country either because of language difficulty or the impossibility of securing the documents. Miss Williams has been responsible for the material from the United States and Canada and Professor Zimmerman for the material from the other countries.

The studies are arranged in the bibliography according to continents or main geographic regions and alphabetically by countries within the regions. Where countries are represented by more than 50 studies a further subdivision has been made into (1) farm families, (2) families of wage earners, low-salaried workers, and small proprietors, (3) other independent families, and (4) dependent families. Within the groups the studies are arranged chronologically. The index is by authors. In addition to the annotations in the bibliography proper an extensive table indicates the inclusion or omission of important types of material in each of the studies. There are 67 items covered for the studies from the United States and Canada and 39 items for the studies from the other countries. This permits the studies in which certain types of information are available to be readily determined. One may, for example, quickly determine which sources give quantity data concerning food. A similar set of tables cover the methodology followed, 28 items being included for the studies from the United States and Canada and 15 items for the foreign studies.

There are also two excellent general discussions of about 30 pages each included in the volume; the first covers the historical development of these studies and the second is on the methodology employed. Miss Williams prepared the section on the history for the United States and Canada and the statement on the methods of the statistical schools. Professor Zimmerman prepared the section on the history of the studies of family living in other countries and the discussion of the methods of the Le Play school.

One is impressed by the variety of the individual studies and the difficulties of combining them for any aggregate or comparison. Most of the investigations appear to have been made with a special purpose in mind and with little thought of their comparability with other work. In the United States the studies have been restricted largely to the low income groups and farm families, but even here the coverage is incomplete. The authors have not only provided us with an excellent bibliography but in bringing all the material together have performed a service in showing that despite its magnitude the existing information is highly heterogeneous and incomplete.

WARREN C. WAITE

University of Minnesota

*Statistical Confluence Analysis by Means of Complete Regression System*, by Ragnar Frisch. Oslo: Universitetets Økonomiske Institutt. 1934. 192 pp.

Professor Frisch's important work is dedicated to the proposition that all variables in a regression analysis are created equal. He proposes, as a substitute for the usual multiple correlation methods, a complex procedure which begins with the square matrix containing all possible zero order correlation coefficients among the  $n$  variables which it is proposed to study, continues through an impressive if bewildering maze of adjoint determinants (which must be computed for all possible subsets contained in the "big set" of  $n^2$  simple correlation coefficients), and concludes with a very unusual "scatterance" and "bunch" analysis from which he draws forth what he feels to be the appropriate regression. It is quite impossible to outline the technique Frisch employs. It will be difficult to present the aims and purposes of the book. But if there is one essential *raison d'être* of this approach, it is the effort to displace the habitual selection of one variable as the "dependent" variable and the casting of all others into the category of "independent" variables, with an approach which will display no disposition to minimize the sumsquares along any particular axis of the  $n$ -space postulated by the geometry of the regression problem.

A discussion of this work properly involves a consideration of at least two other publications. The first of these is a shorter, preliminary paper by Frisch ("Correlation and Scatter in Statistical Variables," *Nordic Statistical Journal*, Vol. 1, (1928), pp. 36-102). The second is the work of L. L. Thurstone, Professor of Psychology at the University of Chicago (*The Vectors of Mind*, Chicago, 1935, University of Chicago Press). Frisch is not a facile writer of English, and, although the service he does English readers by putting his important contributions in their language is a major one, all who seek to understand *Confluence Analysis* must prepare themselves for the translation of familiar concepts from the unusual exposition and notation Frisch employs into more customary idiom and symbol. In this task the 1928 paper will be found of great assistance.

Most remarkable to this reviewer are the astonishingly parallel yet clearly independent developments of the application of matrix algebra to the interrelations of several statistical variables which have taken place in the two Frisch papers and in the writings of Professor Thurstone. Thurstone's shorter papers on the subject (which he calls "factor analysis," a term American statisticians are likely to prefer to "confluence analysis") have been published from time to time, beginning in September, 1931, with "Multiple Factor Analysis," in *Psychological Review*, XXXVIII, No. 5, pp. 406-427. Thus, although it is clear that none of Thurstone's articles antedates Frisch's 1928 paper, several of them precede *Confluence Analysis* by two or three years. Yet Frisch's later work makes no mention of Thurstone, and in the latter's masterful *The Vectors of Mind* (an excellent summary and completion of his "factor analysis") the Frisch studies are not referred to.

Frisch does seek an empirical criterion which will tell us whether a certain

variate ought or ought not to be included in the regression. His answer is a comparison of the deviation sumsquares along each of the coordinate axes of the  $n$ -space in which the regression problem is posed. Then he compares the "spread" of the results of the several minimizations with their "average" value. He deliberately avoids assigning a probability to any of these results, such as the ratio of spread to average. He is not convinced such a probability would have significance, and anyway he prefers to rely on intuitive judgment whether a spread is "reasonable."

One is justified in imposing on Frisch the burden of proof that the regression coefficients his method yields possess a reliability not enjoyed by those calculated from the same data by the ordinary multiple correlation techniques. This Frisch seems not to have done. A very real service, however, is performed by any writer who forces statisticians to reexamine the hypotheses implicit in the procedure they employ. This Frisch certainly has done. No one can read *Confluence Analysis* and then select, as the dependent variable with reference to which a multiple correlation analysis is to be performed, the first variable which comes to mind.

FRANCIS MCINTYRE

Stanford University

*Essential Traits of Mental Life*, by Truman L. Kelley. Cambridge: Harvard University Press (Harvard Studies in Education, Volume 26). 1935. 145 pp. \$2.75.

In the first portion of his new volume on factor analysis Professor Kelley offers a new method for obtaining Hotelling components. The matrix for analysis consists of variance and covariance instead of correlation. The object is then to eliminate covariance from the original matrix and arrive at components which are uncorrelated and measured from orthogonal axes, with variance a maximum in the direction of the major axes of ellipsoids of uniform density.

The process consists of selecting the largest covariance,  $p_{12}$ , in the matrix and making an orthogonal transformation of the original variables through an angle  $\theta$  given by

$$(1) \quad \tan 2\theta = \frac{2p_{12}}{v_1 - v_2}$$

where  $v$  represents the variance. It may be easily verified that this transformation gives uncorrelated components  $y_1$  and  $y_2$  with maximum variance in the direction of the major axis ( $y_1$ ), and minimum variance in the direction of the minor axis ( $y_2$ ). The largest new covariance is then selected and the process repeated over and over until the final covariance is sufficiently close to zero by sampling tests.

The final result is an orthogonal transformation of the original  $n$  variables in terms of  $n$  components. It is thus possible readily to obtain expressions

for the  $n$  components in terms of the original  $n$  variables. Mathematically the whole process of analysis is very simple and direct but probably very laborious, because for  $n$  variables the number of necessary rotations is of the order  $n(n-1)/2$ .

A work sheet and a ten-variable illustration are presented, but to date none of the Hotelling methods or modifications have been applied to adequate test material. Such applications are much needed because the illustrations so far appear to yield trivial and unimportant results. Thus, in Professor Kelley's ten-variable problem, nine components are required to interpret the results. These nine components appear to the reviewer little better than the ten tests themselves and yield no parsimony of interpretation. He should like to see how many significant components would emerge from an analysis of fifty variables.

It is necessary by Professor Kelley's method to use original units rather than standard scores, for in the latter case  $v_1 = v_2$  in formula (1) and all initial angles of rotation become  $45^\circ$ , which furnishes a trivial solution. The final components must thus be expressed in terms of the original test units and variances, and this necessity appears to the reviewer a distinct limitation of the method. It is true that arbitrary weights may be attached to the variables, as Professor Kelley suggests, but this procedure merely results in an arbitrary allocation of the components according to the size of the weights. Thus, if variable 1 is so weighted as to have the largest numerical variance, it will be the most heavily weighted with the principal component.

If it is desired to modify Professor Kelley's components to reproduce the original correlation instead of the covariance, it is sufficient to standardize the components. When this is done, however, the matrix of transformation is no longer orthogonal, and the consequent simple mathematical properties are lost. It may also be observed that by Hotelling's method of iteration, expressions for tests in terms of components are obtained (as on p. 60) in which the coefficients do not form an orthogonal determinant. The analyses of Hotelling and Kelley are thus fundamentally different with respect to the property of orthogonality of transformation.

In the remaining chapters Professor Kelley discusses various approaches to the analysis of mental traits and criticizes those of Spearman and Thurstone. The comment on Spearman's Two Factor theory (p. 39) is confined largely to an objection to selecting tests according to the tetrad criterion to obtain a single general factor, and the failure to bring other factors into the picture by a wider sampling of human activity. Since these problems have been dealt with by Professors Spearman and Kelley as members of a joint committee, the comment appears irrelevant.

Thurstone's center of gravity technique is also criticized chiefly on the grounds that the specific non-chance variance should be analyzed. It is also shown that Thurstone's components are simple averages of the variables. Both these objections, the reviewer believes, are met in Thurstone's recent volume on *The Vectors of Mind*.

Professor Kelley has furnished an ingenious and mathematically elegant technique for component analysis. The recent methods of Spearman and Thurstone, however, appear to the reviewer to have greater promise from the standpoint of psychological interpretation and parsimony of description.

KARL J. HOLZINGER

University of Chicago

*An Outline of Probability and Its Uses*, by Maurice C. Holmes. Ann Arbor Michigan: Edwards Brothers. 1936. viii, 119 pp. \$1.50.

The preface states that the book is designed primarily for students of science and engineering. The contents could be covered in two semester hours. Calculus is prerequisite. Besides the usual introductory matter, brief discussions are given on the Tchebycheff inequality, probability paper, Bayes' theorem, Lexis theory, the Pearson curves, beta diagram, chi-test, correlation, and regression. Examples, solved and unsolved, are presented. Only one obscure passage is noted; at the bottom of page 96 it would have been easier to say, "If from the data we compute and plot for any given height  $y$  of sons the mean height  $x$  of their fathers, we obtain the line  $A$  of figure 22. Again, if we plot for any given height  $x$  of fathers the mean height  $y$  of their sons, we obtain an entirely different line,  $B$ ."

It was the fact that the heights of sons tends to step back or *regress* toward the general mean that led Galton to the term "line of regression," and it is pleasing to find this bit of history mentioned. Other good points are made; e.g., on pages 34 and 72 occur excellent discussions of a priori probability, and on page 95 an interesting account of the coefficient of correlation as a measure of common causation. The St. Petersburg paradox and Buffon's needle problem are expertly handled.

The book is an excellent job of printing by lithograph from pages typed with care but not without flaws. Misprints are as follows:

Page 6, line 26, and page 7, line 5; read  $e_1, e_2, e_3, \dots$

Page 6, line 27, and page 7, line 9; read  $p_1, p_2, p_3, \dots$

Page 11, Eq. (10); insert  $\sum$  in front of the left-hand member.

Page 23, bottom; read  $C e^{-k(u^2+v^2+w^2)} du dv dw$ .

Page 45, footnote c;  $\phi(x)$  in the left-hand member should not be capitalized.

Page 47, bottom; read Wiley 1923; Longmans 1925.

Page 56, line 15; for "are" read "is."

Page 70, bottom; for "toward the origin" read "toward unity."

Page 72, bottom; for "chance" read "change"; in line 28 read Lexis.

Page 82, Eq. (44); for  $1/2\sigma^2$  in the exponent read  $\sigma^2/2$  or  $\frac{1}{2}\sigma^2$ .

Page 84, line 20; read  $m_1 = 0$ .

Page 84, bottom; transfer  $\sigma$  from numerator to denominator.

Page 88; in both equations for  $P$  insert  $+$  before the last terms.

Page 89, line 18; read Nos.

Page 95, top; the exponent should carry signs +, +, -.

Page 108, fourth list, No. 4; read Whittaker and Robinson.

Page 111, line 6; insert = after  $n!$

More serious than misprints are unguarded statements such as on page 111; the series for  $n!$  is divergent but asymptotic, not "rapidly converging." Moreover,  $n!$  departs ever wider and wider from  $n^*e^{-n}\sqrt{2\pi n}$  as  $n$  increases; it is the *percentage* discrepancy that steadily diminishes. It is a shock to see a list of "Probable Errors of Statistical Constants," as on page 112. The author in the preface commits himself to the objective view of probability; just why nature should be expected to bow to probability equations we are, however, not told; yet on pages 31 and 34 and elsewhere this assumption is apparently taken for granted.

On page 41,  $\bar{x}$  is apparently the mean of  $n$  observations; if so, then  $x - \bar{x}$  is a residual and not an error; moreover, the  $\sigma^2$  in Eq. (21) should be replaced by  $\sigma^2(n-1)/n$  if  $\sigma$  denotes the S. D. of an infinite number of observations. Or if  $\sigma$  denotes the S. D. of the  $n$  observations, as it does on pages 70 and 71, then the normal curves of Eqs. (20) and (21) should be replaced by Student's curve, which, by the way, is not mentioned. On page 71 the *mode* of the sampling distribution of S. Ds. is arbitrarily chosen for an estimate of  $\sigma'$ , leading to the factor  $n/(n-2)$  in place of Gauss'  $n/(n-1)$ ; and there is no mention of any other possibility.

The vertical axis of figure 15 on page 71 should be labeled "relative frequency per unit of  $\sigma/\sigma'$ ," and not merely "relative frequency." Furthermore, the curve for  $n=4$  should start from the origin with a horizontal tangent; likewise the curve on page 19. By the unorthodox classification of Pearson's curves on page 81, the normal curve is Type VII, and there is no mention of the Student curve, or the Type II curve with the two parameters reversed in sign, yet in the beta diagram on page 87 the normal curve is clearly and properly the limiting separation of Types II and VII.

Just why probability is measured in *decimal* fractions (page 3) the author does not disclose; does he perchance mean *rational* fraction? A captious critic might be annoyed at the curious use of three dots ( $\dots$ ) here and there, as on pages 18, 21, 24, 27, 62, 86, and elsewhere; or at the novel capitalization. Why, for instance, should theoretical on page 89, and fathers on page 96, be with capitals, yet new sentences on page 101 and 102 be without? Redundant parentheses abound; thus, on page 14 we see  $(32)/(100)$  where  $32/100$  is preferable. Unattached participles occur on pages 12, 35, 46, and 57.

The author pays his debt to Fry by thrice mentioning his *Probability and Its Engineering Uses* in the lists at the end. Rietz's *Carus* monograph is slighted, whereas his *Handbook* receives double mention.

W. EDWARDS DEMING

Bureau of Chemistry and Soils  
U. S. Department of Agriculture

*Statistics for Students of Psychology and Education*, by Herbert Sorenson.  
New York: McGraw-Hill Book Company. 1936. viii, 373 pp. \$3.50.

The author of this book quite evidently has had to contend with the difficulties of students who ask questions which the conventional textbook does not answer. Also, equally evident, he has been influenced by the fact that all too often his students reveal on examination day an abysmal ignorance of some of the things which the instructor thought he had made quite clear. These are shown by the encyclopedic treatment of some of the topics [the mean and the median, for example, consume 50 pages]; by the using in many places of two numerical substitutions in a formula instead of the conventional one; by pointing out incorrect methods as well as correct; by the number and variety of problems presented; and by the ingenious and concrete examples and illustrations frequently used.

In the preface we are told that the book aims to put its emphasis upon interpretation, logical analysis, and application of techniques; and to develop wholesome skepticism, critical attitude, and a keen qualitative sense (p. iv). The promise is better than the realization. The space which might have been devoted to many concrete problems for critical discussion is occupied by much irrelevant material of which "The Theory of the Normal Frequency or the Normal Probability Curve" (pp. 161-162) is an example, where, after developing the excellent pedagogical device,  $(H+T)^n$ , to replace the  $(\frac{1}{2} + \frac{1}{2})^n$  in the conventional penny-tossing experiments, he fails rather signally to show any connection between such and the results of experiments, unless the very cryptic, "if a very large number of coins were tossed, the broken line connecting the tops of the verticals representing the frequency of the obtained combinations would approach a normal curve," be so dubbed.

Although the book has many excellent features summarized in the first paragraph, it lacks proportion and balance. The quality of treatment is spotty. In the first 160 pages we are taken through the averages and measures of variability; then, in the next 184 pages, through a grand sweep of formulae and concepts in which the intellectual difficulties of elementary students relatively are forgotten. Evidently this is done to justify the book as a two-course book which "... contains essentially all the elements of statistics actually used by most graduate students." If intended to be used as a two-semester text, the book, in our opinion, does not go far enough into advanced topics.

This is one of the few texts in which, after having made the distinction, the author strives to do something with "continuous" and "discrete" measures. The result, particularly in the case of the median (which thus is made to cover 20 pages of the text), is, in the reviewer's opinion, disastrous. The reviewer has yet failed to locate a case of discrete measurements in which making the assumption of continuity would not lead to better insight, and better comparability of statistics from study to study than by attempting to deal with the scores as discrete. One wonders what, if anything, the

median (either discrete or continuous), or any other measure of central tendency, means for any such series of ten scores as 6, 7, 9, 11, 13, 15, 16, 17, 18, 19; also whether the student is helped or hindered by statements such as: "When the data are discrete and odd in number, then the middle number is the median (p. 71)." That the median is a point seems not to have been appreciated; that it may be treated most economically as a special case of all percentiles has been ignored.

With the exceptions noted, the statistical practices used are excellent. We did note figures printed at the ends of bar charts (p. 30), but there is good precedent for this aberration. A valuable exercise to develop thinking about functional relationships is to be found in some 60 examples of relationships (pp. 186-188) wherein the student is required to judge whether the correlation is positive or negative. The chapter on Sampling, Chance and Probability of Occurrence is decidedly concrete and appropriate to the kinds of students for which it is intended.

Derivations of formulae are conspicuous by their all but total absence.

If supplemented with an abundance of real problems to develop more fully the intended criticalness of judgment—particularly in the second half of the book—it is the reviewer's judgment that the text will be more effective than the average. A two-course book deliberately intended to be interpretative but "not to the neglect of computational skills or the statistical techniques themselves" with difficulty is packed into 373 pages of large type.

HERBERT A. TOOPS

Ohio State University

*Graphs—How to Make and Use Them*, by Herbert Arkin and Raymond R. Colton. New York: Harper & Brothers. 1936. xvi, 224 pp. \$3.00.

*Graphic Methods for Presenting Business Statistics*, by John R. Riggelman. New York: McGraw-Hill Book Company. 1936. *Second Edition*. xiii, 259 pp. \$4.00.

*Rich Man, Poor Man—Pictures of a Paradox*, by Ryllis Alexander Goslin and Omar Pancoast Goslin. New York: Harper & Brothers. 1935. viii, 85 pp. \$1.00.

Professors Arkin and Colton have provided a brief, readable book on graphic methods, doubtless quite adequate as a text for an elementary one-semester course in graphic presentation. It is not complete enough, however, to serve as a reference book, and the publishers do the authors an injustice when they claim "... every phase of the technique of making and using graphs is here discussed ..." and again when they assert "not only are all the different methods of graphic presentation described in detail but illustrations of all applications are reproduced from a number of fields. ..." Publishers should refrain from claiming an inclusiveness which greatly exceeds the author's intention. There is more emphasis in this book on "how



to make" than on "how to use" and almost nothing is said about how and where to obtain the necessary basic data. There is a valuable chapter on "The Equipment for Graphic Presentation" which, however, seems to the reviewer to be so placed as to be somewhat in the nature of a digression. There is a chapter entitled "Graphs for Computation" and another dealing with "The Reproduction of Graphs." The chapter on "The Ratio Chart" could have been expanded with profit; as it stands it is definitely less complete than the corresponding treatment in various general textbooks on statistical methods. The polar coordinate chart, the 100 per cent triangle, and the arithmetic probability chart are included in the chapter which discusses ratio charts. A separate chapter could well have been devoted to these and other devices.

Dr. Riggelman's book is a revision of his earlier book (1926) of the same title. The topics discussed are the same as before, but the chapter on "Technique of Drawing and Lettering Statistical Charts" has been shifted to the appendix. The charts and illustrations were profuse in the original edition, and there has been but a slight increase in the new edition. Many are new, however, and some time series charts have been brought up to date. The general appearance of the charts has been improved by frequent substitution of block lettering for titles and scales in place of freehand or typewritten lettering previously used and by the use of better chosen hatching and shading for bar charts. Some of the charts in the second edition (for example, numbers 38, 40, 110, 132, 141) appear to show the same data as before revision but with new dates. This, however, is permissible (except in the case of Chart 141), as they are merely shown for purposes of illustration and are not designed to fix a date-connected fact in the mind of the reader. It is a tremendous task to bring up to date a book having more than 250 charts. There are a few which were neglected. Chart 55 (Why it Costs so Much to Mine Anthracite), which is undated, would doubtless be different today, as would also Chart 88 (Hourly Traffic and Operators Required in a Telephone Office) and Chart 174 (Stopping Distances for Motor Vehicles with Efficient Brakes), which are likewise undated. Chart 56 (How the American Family Spends its Dollar) has been altered, but in neither edition did this chart have a date to identify it.

Although the Riggelman book has no chapter on "Graphs for Computation," it is more complete than the Arkin and Colton book in respect to graphic technique and illustrations of charts. Organization and routing charts, which are discussed by Arkin and Colton, are omitted by Riggelman, since they are not based upon statistical subject matter. Arkin and Colton are more meticulous than Riggelman in stating the sources of charts and data.

*Rich Man, Poor Man* is "part of the educational program of the People's League for Economic Security," and it "presents in a nut-shell the philosophy of the League, a philosophy which the League aims to see realized one day as a practical reality." The pictorial charts were prepared by Delos Blackmar; Willard A. Atkins functioned as economic adviser to the authors. The

dust cover carries the names of the editorial committee (Stuart Chase, Henry Pratt Fairchild, and Harry A. Overstreet) but fails to give the authors their proper mention. This ultra-elementary presentation is an argument for the social ownership of means of production, credit, power, transportation, and distribution and is incidentally an appeal for additional members for the League. Technically this book leaves much to be desired. The combination of soft, porous paper and blue ink is not all that could be wished for. Compare, for example, the chart on page 25 with the same chart reproduced in black and white on page 104 of the Arkin and Colton book. An appendix gives the sources for charts and data, arranged by chart numbers, but, unhappily, the charts are not numbered. For their data the authors sometimes referred to primary sources, but more often not. In either case they do not comment on the reliability of the data used. There is not space here for detailed comment or criticism, but the repeated and unrelieved use of small-figure pictorial charts seemed to this reviewer to become monotonous, and the chart on page 6 brings forth once again the unwarranted association of horses and horse power.

FREDERICK E. CROXTON

Columbia University

*On Quantitative Thinking in Economics*, by Gustav Cassel. Oxford: The Clarendon Press. 1935. vii, 188 pp. \$2.25.

Professor Cassel believes that economists must "relieve themselves of the oppressive burden of withered notions and barren dogmas" and in this volume endeavors "to indicate the principal lines of the work required and to illustrate its nature by discussing some few important points relating to the basic concepts and methods of economic science." To this end he develops chapters on production, value and money, income and its use, gradual approximation, quantitative relations between product and factors of production, and the equilibrium theory of prices, which draw heavily upon his *Theory of Social Economy* and consider various criticisms of his published work of this nature.

With justifiable indignation Professor Cassel condemns writers possessing superficial knowledge of mathematics who represent vague concepts, often of little or no economic significance, by mathematical symbols and attempt to draw authoritative conclusions from mere mathematical processes. He rightly insists that "in choosing our definitions we must always let the economic point of view be decisive," and that "as far as quantitative concepts are concerned, their quantitative character should be made quite clear, their measurability be unambiguously established, at least as a theoretical possibility, and a definite unit of measure be fixed." Professor Cassel next declares that "no definite meaning can be attached to the idea of a period of production," except in a money economy where both efforts and wants are represented by prices and an average of periods would be conceivable. But he then seems to become confused over the nature of an average, stating

that such is a sum of quantities divided by their number and entirely ignoring in later discussions possibilities of harmonic, geometric, and other useful averages. Other examples of unskilled mathematics appear on pages 17 and 134.

In a discussion of value and money, the author declares that "the idea of an absolute value of a thing in itself has to be abandoned in economic science—definitely and forever." Values must be replaced by prices, and "economic theory must start with the construction of a general theory of prices." Such a theory can, of course, be quantitative, and, as he states, to superimpose upon it such pseudo-scientific notions as utility or value as a thing in itself is a disservice to economics. The author then advances four arguments in favor of a monetary system based upon a fixed-price-level standard. In the course of discussion he maintains that nations should first adopt suitable standards—usually based on wholesale prices although the particular base is apparently of no great importance—and compel the economic systems, both internally and in relation to other countries, to adjust to these standards. Criticizing severely a publication of the League of Nations based on the assumption that technical advance should be reflected in a falling price level, Professor Cassel maintains that higher wages and increased standards of living would be the outcome under a fixed-price-level standard.

The author next attacks the "popular fallacy" that "saving renders a part of the social income inoperative as purchasing power," thus differing widely with Keynes and others. Here, however, Professor Cassel distinguishes between purchasing power as he defines it and the supply of means of payment as others define it, the difference appearing to the reviewer as a hair-splitting quibble. In this chapter the author appears to go to unnecessary extremes in his frequent severe criticism of the work of other theoretical economists.

Despite its name, the book is characterized by a notable lack of use of the best modern statistical techniques. For instance, in discussions of deviations from theory in Chapter II, no recognition is given to the problem of statistical significance, whereas this is the fundamental problem of approximations. Again the argument on page 98 regarding the character of wave-like motions of business data lacks force because of this underlying failure to consider at all questions involving significance. Consequently, the reviewer cannot reach Professor Cassel's conclusion that there is no general problem of the business cycle and that "the very question why the actual development should follow a curve composed of successive ups and downs is not a problem that requires an answer, such a movement being simply self-evident necessity." In support of the reviewer's position it may be noted that he has collaborated in deriving a quantitative demand curve for residential building and demonstrated that the mere striving for profits in this industry leads to a self-perpetuating cycle, because of the functional nature of the demand.

The reviewer must also disagree heartily with the statement that one must always go back to the pre-War days for data to prove or disprove theses relating to business cycles, because post-War monetary disturbances have been great. A useful picture of business cycles must represent both periods,

such as does, for instance, the study of building above mentioned. Also the reviewer believes that the author is entirely too pessimistic regarding the possibilities of economic forecasting. Thus, even with such political interference as occurred under the National Recovery Administration, the majority of forecasts made by its economic staff of outcomes of various NRA experiments were essentially accurate.

In the reviewer's opinion by far the best chapter is that dealing with product and the factors of production, wherein is given an able criticism of the marginal productivity theory and attempts of Douglas and others to test it in simplified form. Here the notion of continual growth, both of labor and capital, such as is found in the writings of Carl Snyder and others, are developed at length. It is only in this chapter that the book even approaches the quantitative stage; figures taken from Mills, *Economic Tendencies in the United States* and from other workers are cited at length. But not all the interpretations are correct; for instance, the author speaks of great progress in the building industry in the years 1923-1929 as a trend, whereas there is no sharply upward long-time trend in building activity, and examinations of long series for this industry reveal nothing unusual about the 1923-1929 cyclical upswing in the long building cycle of 15-20 years, which, according to Professor Cassel's definitions, would be random.

On the whole, however, this little book is challenging and well-written and deserves the careful study of all students of economics.

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*Income and Economic Progress*, by Harold G. Moulton. Washington, D. C.: The Brookings Institution, Publication No. 68. 1935. xi, 188 pp. \$2.00.

This book is the last (fourth) volume in a series of studies published by The Brookings Institution. These studies, widely discussed throughout the world, aim at determining the decisive deficiency that prevents the economic machinery from working at full speed and, moreover, from attaining the perfection that could have increased its efficiency far above its present level. Mr. Moulton presents many striking data that are known to the readers of the former volumes.

The point he makes in this book is the following: Mr. Moulton discards the opinion that at any time in this country consumption surpassed the proper limit, hampering the accumulation and investment of capital and hence the increase of production. On the contrary, consumption could have been always considerably above its level without any danger for the development of the productive forces. The main problem, therefore, is not how to retard the upward movement but how to keep production on the level that it attains during the boom—or, which amounts to the same, how to increase consumption. This being his main view, Mr. Moulton can be classed as an

under-consumption-theorist; not, of course, in the primitive sense in which this theory has been usually interpreted by orthodox economists. He discusses the means usually suggested, namely: equalization of incomes; taxation; and raising money wages. These measures would not help, he believes.

So by excluding these possibilities he proposes that price reductions are the appropriate measure for eliminating the hindrances that are in the way of a quicker and uninterrupted economic growth. He insists that this proposal is in line with the opinion of classical economists: price reductions would spread the advantages of technical progress over the whole economic field; not only workers but every consumer then shares the fruits of increasing efficiency; even profits would not decline, as the increasing output reduces the overhead costs and might, at lower prices, yield higher profits. (This last statement, however, would hold true only for commodities which satisfy an elastic demand.) Thus Mr. Moulton expects that this perfect harmony, of which the laissez-faire economists dreamed, may be established and the progress of our economic system might be secured without any serious setbacks.

The general principle expressed in this trend of thought is widely shared. It is almost common opinion that rigidities are in the way of full utilization of our potential productive power. But there are differences as to the center of these rigidities: one group of economists is stressing the rigidity of wages, which, being the main costs, are responsible for the restrictions in production; the other group is stressing the rigidities of prices, interest rates included. This difference runs parallel to the difference in opinion concerning the abundance or scarcity of capital. But both views aim at the restoration of free competition.

If rigidities are the main trouble, and if these rigidities did not exist in the first period of our industrial age, the question has to be answered: what are the roots of these rigidities? They center mainly in the technical changes of production that did away with the basic feature of a competitive market: namely, that the single producer can contribute only an infinitesimal share to the total production. It was this feature that guaranteed competition, increasing production, and thus price reductions parallel with reduced costs. Mr. Moulton elaborates this point on the lines of the generally accepted view. But he insists that prices should be reduced according to reduced costs. Even if we accept this view, how can it be done? How can free competition be restored? That is the crucial point. Mr. Moulton does not pretend to solve the problem in his book; on the contrary, he says that it would be a complicated task (p. 164): "It would need to be highly detailed to meet the peculiar situations of varying industries, and the time is not yet ripe for the presentation of anything more than general principles." But one must ask the urgent question: How can the aim be achieved unless a central economic authority can enforce increasing production, if a smaller production at higher prices is decided upon by the owners of the industrial enterprises? Furthermore, what shall be the measures this central authority shall take? Publicly owned production ("yardsticks") or commands? How can private business

be made to obey these orders unless the economic authorities guarantee a minimum of profits? And so on.

Probably questions of this kind explain why only the general principle was stated by Mr. Moulton, who, by the way, shuns the establishment of any dictatorial economic authority.

Now we cannot close our eyes to the fact that the very basis of our potential economic efficiency, namely, large scale production, is, in the opinion of Mr. Moulton, the reason why free competition does not work. We are confronted, in other words, with an antinomy of the system, as the same forces that accelerate production retard the speed of the machinery: Now it seems that there is no way to eliminate the rigidities except by breaking up the great units of large-scale production. And that would mean, in many cases, the return to an older and less efficient technique. We could get rid of the rigidities but of the high efficiency of modern production at the same time. Thus, we have to take the rigidities as a fact, and we have to use them, if possible. Those who would eliminate the retardations must accept the economic machine in its present working and must try to accelerate its speed by other devices. They can be—if the present system is to be preserved—only measures of monetary policy, as they were taken during recent years, namely, devaluation and public spending. These measures would not be necessary perhaps if rigidities (i.e., lags) did not exist. But as we cannot get rid of the lags, we have to use them—which is, in my opinion, the kernel of the economic policy advocated by J. M. Keynes and those economists who more or less side with him.

These devices are certainly no panacea, though they proved to be workable to a certain extent. The basic problem, however, is not solved by them. This point cannot be discussed here, but it may be said that it is questionable whether even a perfect flexibility could assure the full working of our economic machinery if labor-saving devices and technical progress surpass a certain limit. A careful analysis of the consequences of technical progress should, I think, give some hints for a better judgment about the processes through which our present economic system tends to under-utilize its capacity, and, hence, about the measures that can be taken in order to secure its full working.

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*The Future of Gold*, by Paul Einzig. New York: The Macmillan Company.  
1935. x, 135 pp. \$2.00.

This interesting little book by an Englishman sets out to answer the following four questions:

1. What will be the course of the London price of gold in the near future and in the more distant future?

2. At what level will sterling and other principal currencies be stabilized?
3. What kind of monetary systems will the leading countries adopt when returning to stability?
4. What will be the tendency of gold and commodity prices after stabilization?

His analysis no doubt is of more interest to England than to the United States. The price of gold continues to change in England, and shares of gold mining companies occupy a more important place in the investments of Englishmen than of Americans.

The author's conclusion that the London price of gold would certainly rise within two years was based on the following assumptions:

1. That the balance of payments would tend to depreciate sterling.
2. That the United States would certainly depreciate the dollar to 50 cents gold and perhaps even further, and that England would follow at least in part. Even though France devalued or allowed the franc to depreciate there would be little effect on the sterling price of gold unless the United States devalued or depreciated with France. In such an event, the pound would be allowed to depreciate with the dollar.
3. That decided improvement in economic conditions must occur before hoarders would liquidate their gold stocks.

The author pointed out several tendencies in support of the contention that the balance of payments would tend toward a decline in sterling. He argued that foreign lending would increase, that English securities held abroad would be returned, that several of the dominions would use sterling balances already acquired to pay debts to England, that the Exchange Equalization Account never sold as much gold in support of sterling as it had previously purchased, and that political factors favored sterling depreciation. These factors no doubt support his conclusion, but as yet their effect has not been sufficient to cause a decline in sterling.

The reviewer feels that the probability that the United States will further depreciate the dollar in this readjustment period is small. It is the reviewer's opinion that an advance in the price of gold in France which is less, the same, or somewhat more than the advance that has already occurred in England will have little or no effect on the London price. If these statements are true the author's second reason for a higher gold price in London has little weight. With the influence of the United States and France eliminated, the chances for a rise in the price of gold in London do not appear so great as the author contends.

The third reason that gold hoarding would continue until there are decided improvements in economic conditions, is probably true.

The author comes to the conclusion that a large share of the world will return to a gold standard. He believes, however, that stabilization will not come for a number of years and only after heavy devaluation by a large number of countries.

The author reaches the conclusion that currencies will be devalued and stabilized at such a rate that currency prices in all participating countries

will rise, because "... It is impossible for all currencies to be undervalued in relation to each other. It is, however, quite possible for all currencies to be undervalued in terms of gold. . . ." The author means by "undervalued in terms of gold" that prices in each country will rise after devaluation and stabilization in proportion to the amount of undervaluation in terms of gold. Hence he reasons that stabilization will not mean falling prices and deflation to any country but will result in rising prices in all countries. The amount of rise in each country would depend on the undervaluation of its currency in terms of gold.

There is a question whether or not most currencies are not now undervalued in terms of gold. Will not commodity prices in the sterling block, in the United States, and even in the remaining gold countries rise without further devaluation? The present purchasing power, or value of gold, is still approximately at the peak of the crisis and too high for its relative supplies, and most countries can anticipate higher price levels without further devaluation. With the heavy devaluations anticipated by the author, the increase in price levels will be even greater.

It seems to the reviewer that the author has overestimated the chances of further advance in the London price of gold and by implication has exaggerated the investment possibilities of gold and gold mining shares. If the purchasing power of gold declines, gold and gold mining shares will not be as profitable as formerly, and in fact other types of investments will probably be more profitable.

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*The Theory of Monetary Policy with Special Reference to the Relation between Interest Rates and Prices*, by Bhalchandra P. Adarkar. London: P. S. King & Son, Ltd. 1935. xi, 125 pp. 7 s. 6 d.

Mr. Adarkar's book is well worth reading. Its value lies not in any major solution brought forward but in the penetrating and thoughtful comments on current ideas. He has a wide knowledge of the literature of interest-rate theory and a very real ability in combining the doctrines in this field with those in monetary theory as more narrowly defined. In making a broad survey of the dominating concepts he lays the groundwork for further progress.

The book is in no sense confined to a reiteration of old truths but throws new light on obscure problems. If one attempts to summarize the contribution in this study, one gives a somewhat false impression, because the cautions and suggestions sound familiar, but careful reading makes it evident that there is a somewhat new combination of ideas on policy and that even such well-known warnings as those urging central bankers to apply the brakes before speculative movements get out of hand are phrased in a manner which gives them a new force and which makes their application to specific situations somewhat more definite.



The faults in the book are immediately clear even to those who welcome its serious tone and its honest attempt to get at the fundamentals. The book covers a very wide area and a considerable span of time. It does this with surprising success in the short compass of 125 pages. In view of the limits imposed by the essay-like structure, it is not surprising that one reads the treatment of certain theoretical points with a strong desire for more complete elaboration and more emphasis on major issues.

When, for instance, Mr. Adarkar discusses the Riefler-Keynes theory of the relation between long and short money rates, he is getting to the heart of his problem. A brief five-page treatment of the matter leaves the reader somewhat up in the air. The general outlines of the theory and the nature of Professor Simmon's criticism are clear. When, however, Mr. Adarkar amplifies his own ideas and asserts that central bankers can control long rates but not mainly because of a necessary relation between short and long rates, one wishes for a further elaboration of his reasons. His summary statement that many instruments are available to the monetary authorities, including open-market operations and similar instruments, leaves one with a sense of incompleteness. The general nature of his treatment implies that he has thought the matter out somewhat concretely, but the two or three paragraphs devoted to his constructive advice at this point are insufficient to bear the weight of his conclusions.

These criticisms are intended to indicate points at which some readers will object to the manner of treatment. There are other points at which some will disagree with the particular theories brought forward. Neither history nor a summary of gold-standard doctrines bears out the comments made on the role of international gold movements. Too large a responsibility has been thrown on this mechanism of adjustment in Mr. Adarkar's discussion. It is rarely claimed that the movements of the precious metals can adjust cost and selling prices to each other either within or between countries. Even the classical economists assume a complex interplay of competitive forces in many markets. Moreover, even this many-sided adjustment only brings a temporary and occasional balance of prices.

A sounder criticism of the gold standard grows out of the claim that it has greatly accentuated and prolonged depression conditions, but this assertion is only valid when expressed in terms of the uneconomic strains exerted on the monetary system by post-war debts. It will be difficult to reconstruct the sadly impaired money systems of the western world if it is not recognized that a reasonable management of international credit conditions, some cooperative efforts to share gold accumulations and investment resources in a rational manner, can moderate price fluctuations. If a completely fatalistic or mechanistic attitude towards the collapse of pre-depression prices prevails, no progress can be made.

A number of comments and criticisms would be worth quoting, but it is better to refer the reader to the text, as the value of the discussion lies so much in the considered judgment of the phrasing and the attempt to combine somewhat divergent views in a coherent interpretation of real con-

ditions. The remarks on the confused use of "barter" and "Crusoe" economics are worth quoting. The general position taken is nearer Mr. Keynes than that of Mr. Hayek, but the eclecticism manages to salvage a variety of suggestions taken from different bodies of doctrine. If the book runs to later editions, more careful editing of verb forms would greatly increase the effectiveness of the text.

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*Money and Banking*, by George William Dowrie. New York: John Wiley & Sons, Inc., also London: Chapman and Hall, Ltd. 1936. viii, 512 pp. \$3.25.

Professor Dowrie has written a textbook that will, in the reviewer's opinion, become very popular in one-semester courses which endeavor to give the student a broad perspective in this field. It is not cluttered up with an encyclopedic array of facts which so often tax the student's patience as much as his memory. Written in a simple, clear, easy-flowing style, it should arouse and hold the interest of the reader. It is concise, but as a rule not overly so. What the author has to say he says directly; there is hardly a surplus word in the volume. Frequent topical and paragraph headings as well as numerous summaries show careful planning and organization.

The subjects treated are the usual ones in such a text, but the author has wisely given more space than has been customary to central banking in this country and abroad. Five chapters are allotted to this subject. Two additional chapters deal with foreign banking systems, containing much recent information of value. The reviewer believes that some expansion in the discussion of the credit policies of the Federal reserve system would have been advisable. It is doubtful whether the student will gain a sufficiently clear understanding of the technique of credit control and the chain of causation set into operation by such control.

The reviewer would have preferred a more thorough discussion of the relationship between money and bank credit and prices and a more complete history of price movements. The emphasis on the events of the last fifteen years will, in the opinion of some, leave the book somewhat lacking in the presentation of a historical background. Although Professor Dowrie favors a gold standard he is by no means a fanatic in this respect. He will be criticized by some non-orthodox monetary theorists for not giving sufficient space to the strong attacks which have been made in recent years against that standard. In his criticism of much of the monetary policy of the New Deal he is scholarly and restrained, an example which some of his colleagues in this field might well follow. Whereas many monetary economists are demanding a return to the gold standard, Professor Dowrie states correctly that we have been on a restricted form of that standard since early 1934.

The text will lend itself admirably to classroom discussion, for Professor Dowrie has opinions, and he leaves the reader in no doubt concerning them.

A summary of some of his most important conclusions follows. A relatively stable price level is preferable to a fluctuating one. The modern statement of the quantity theory of the value of money (as it is expressed in the equation of exchange) has much validity when properly interpreted, although it cannot be statistically verified. A gold shortage played little part in bringing on the depression. The gold standard of the future must be supplemented by conscious management and by central banks and by agreements leading to the use of gold and its more equitable distribution. The United States should resume redemption in gold bars as soon as practicable. International bimetallism is sound in theory. The gold purchase program was comparatively ineffective, and no further devaluation should be permitted. President Roosevelt is given due credit for having withstood great pressure for more radical monetary legislation. The silver buying program was most unwise. Our monetary system should be simplified still further, since we need only Federal reserve notes and minor coins.

We turn now to the author's conclusions on banking. If the banking system had functioned properly it should have been able through control of credit to have prevented the serious decline in prices beginning in 1929. On the whole, the Federal reserve system has been of value, but it has not been able in the past to exercise proper control over bank credit. Moral suasion, the rediscount rate, and open-market policies have been comparatively ineffective. The bond-buying campaign of 1932-33 was of little help in inducing recovery. The new power of the Board of Governors to vary reserve requirements of member banks, however, is the most powerful weapon it now has for checking an undue expansion of bank credit. It will take great courage to use this and other added powers to prevent the inflation for which the stage is set. It was a mistake to broaden the type of bank asset eligible for rediscount, since the illiquidity of the system has thereby been increased. State chartered banks should be eliminated and all banks brought under national charter. Demand and time deposits in commercial banks should be segregated.

Professor Dowrie's most striking suggestion is one for the reorganization of the Federal reserve system. He would abolish present requirements for membership and transfer the ownership of the reserve banks to private hands. He would then permit any sound bank to have access to the system, as is the custom in many other countries.

He wishes that recovery had been permitted to come from natural causes without so much legislation. But he realizes that in a depression as severe as this one, especially in agricultural regions, it was unavoidable for the Government to endeavor to assist. Although most of the monetary measures taken have been of little aid it was necessary to pass them for political reasons. The Federal Deposit Insurance Corporation has a better chance of success than the former state plans, but it will not be tested until we have another severe depression. It does make the continuance of postal savings unnecessary. The Government should retire from much of its recent activity as soon as possible.

Finally, he urges more international cooperation in monetary matters and

the appointment of a strong national commission to suggest methods of improving our monetary and banking system. The greatest compliment the reviewer can pay Professor Dowrie is to suggest that he would be a valuable member of such a commission.

It has been a long time since the reviewer has read a book on money and banking in which he has found so much with which to agree. He wishes the author had said something about social credit and the 100 per cent money plan. In one or two respects, however, the reviewer must differ. He feels that the Government's monetary policy has on the whole been helpful and that the rediscount and open-market policies of the reserve system are stronger weapons, if timed properly and used with sufficient vigor, than Professor Dowrie believes them to be. Finally, there is considerable doubt concerning the practicability of transferring the Federal reserve banks to private ownership.

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*Les Prix Agricoles Mondiaux et la Crise*, by Bertrand Nogaro. Paris: Librairie Générale de Droit & de Jurisprudence R. Pichon et R. Durand-Auzias. 1936. 167 pp. 20 fr.

This book maintains the increasingly popular contention that the divergence between the prices of agricultural and industrial products during the years before 1929 was a major cause of the subsequent depression. In discussing the series of factors to which that divergence is attributable, the author gives a somewhat naïve twist to the story. Emphasis was placed by Timoshenko, in his thorough analysis of the data,<sup>1</sup> on the unbalanced production conditions of the War period and the consequent overproduction and accumulation of stocks. Sir Frederick Leith Ross, in his memorandum to the League Economic Committee,<sup>2</sup> placed somewhat more emphasis on agricultural revival and protectionism in the European importing countries. Ezekiel and Bean<sup>3</sup> emphasized industrial price rigidities which decreased the real purchasing power of farm producers. Emphasis has elsewhere been placed on ineffectual efforts to hold stocks off the market and on the subsidizing of exports in large producing countries. Nogaro mentions most of these factors but places his emphasis on all of them operating together to prevent total world agricultural production from responding to world market price movements as classical value theory ("without wishing to ignore theories since Stuart Mill") provides that it should. He laments the relative lack of rigidity in agricultural prices as "one of the immediate and important causes" of the depression. He says that his analysis of the conditions under which wholesale agricultural prices are formed should contribute to the study of the movement of the general price level and thus to the theory

<sup>1</sup> *World Agriculture and the Depression*, Ann Arbor, 1933.

<sup>2</sup> *Considerations on the Present Evolution of Agricultural Protectionism*, League of Nations, Geneva, 1935.

<sup>3</sup> *Economic Bases for the Agricultural Adjustment Act*, United States Department of Agriculture, 1933.

of money and business cycles. His book, however, seems rather an attempt at synthesis than at analysis.

Starting with an attack on the purely monetary theory of business cycles formerly urged by Cassel and adhered to by the League Gold Committee, the book argues at great length that the greater fall of the agricultural than of the industrial price level was more disturbing than was the general decline of all prices. Cassel is criticized for implying that supply is a constant. Nogaro holds that, as far as agricultural commodities are concerned, it is substantially accurate to consider world demand constant. The book then presents some of the available statistics of prices, production, and stocks for the following commodities: wheat, sugar, beef, coffee, cotton, rubber, wood, and a few secondary cereals and textile fibers. The outstanding characteristics of the market for each of these are briefly mentioned, and the similarity of price movement on these many markets is explained in terms of supply and demand. The fact that this is possible without referring to monetary factors is considered proof of Cassel's fundamental error. Since this negative point is stressed throughout the book, it is strange that Nogaro has based his other main argument on a *divergence* between the prices of agricultural and industrial products.

A chapter is then devoted to the French agricultural market as an example of the direct danger to an importing country from protectionism. Internal production tends to increase. When it is adequate for domestic needs an agricultural depression develops within the formerly importing country which may be more severe than the world depression against which the original protective barriers were raised. It is especially interesting to the reviewer, however, that Nogaro seems to believe that until agricultural prices fall below industrial prices, on the basis of some previous "normal" year, a severe depression cannot occur. Had he picked a country less nearly self-sufficient in agricultural products, he might have found otherwise.

The book does not offer a remedy for the lack of stability which it points out in world agricultural prices. Nogaro thinks that relatively free trade in agricultural products might, by again permitting the focusing of supply and demand at a central market, be a remedy; but he sees no tendency in that direction. He does expect such a tendency to appear, however, unless a new bond (probably an authoritarian one) between price and production is developed out of the numerous attempts at market organization which are now going on.

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*American Agricultural Conditions and Remedies*, Preliminary General Review by the Research Staff of the National Industrial Conference Board, Inc., New York. 1936. vi, 57 pp. \$2.00.

The study of American agricultural conditions and remedies is divided into four parts. The first part, entitled "The American Agricultural Picture

Today," attempts to give the essential features of American agriculture in fifteen pages. It is entirely too general. The conclusion in this section is that American agriculture is in an unhealthy condition owing largely to over-commercialized farming, to the falling off of foreign demand, and to an excessive amount of farm tenancy. The second part, "The Measurement of Agricultural Conditions," does not go extensively into real measurements but rather presents a comprehensive view of farm income, which is very timely. The chief point is that too much emphasis has been placed on per-unit prices of farm products and not enough on income, including both total cash income, value of home-grown commodities, and other sources of tangible and intangible satisfactions. Part three is a brief analysis of "Past Attempts to Help Agriculture." This section deals mostly with the programs of the Farm Board and the New Deal policies. The general conclusion is that, although these programs may have done some good as emergency measures, they have not solved the agricultural problems. They say, "In the case of wheat and cotton, only a concerted world reduction might help, but this is entirely impracticable. For animal products and corn, reduction of production is a false hope for the farmers." The Soil Conservation program as now administered is interpreted as having the same objectives as the A.A.A. on the ground that "the approach is changed, but the objective is the same—the hope of greater farm income from decreased production" This criticism is certainly justified under present administration. Is it not possible, however, that the law itself is not so much at fault and that, guided by different objectives, it might be made the base of a constructive program? Part four presents a "Positive Program for Agricultural Improvement." It is the most stimulating and thought provoking of all. Briefly stated, the program may be summarized in terms of a return to the family-owned and family-operated farm for security of income and expansion of markets; the latter to be the result of the farmer's consuming more products grown on his own farm. In addition to this major remedy, it is proposed to expand markets by having a stronger foreign trade policy and by increasing domestic consumption, to develop a systematic program to discover new uses for farm products, to decrease farm tenancy, to remove submarginal land from wheat production, and to provide outside employment for much of our rural population.

There are a few errors of fact and interpretation such as the reference to Florida sugar plantations, but they need not concern us here.

Summarizing briefly, I think it may be truly said that the main purposes of the booklet are to present a philosophy of agriculture and a program to convert that philosophy into a reality. To the authors, farming is not merely an essential business, it is a way of living that must be preserved as a national policy. They say "The opportunity to establish a large farm population is of national significance from a social as well as an economic point of view and calls for careful consideration and wise leadership." In another place they say "agriculture has an infinitely larger job in the life of the nation than the mere production of its food and raw materials." In view of

the implications of this philosophy, it is no wonder that specialized, commercial, motorized agriculture is looked upon with distrust. It tends to increase the size of farms and reduce the number of farmers. From their point of view, it adds to insecurity of income and tenure. In this connection, they say "the deeper instincts of the farmer himself seem to be pointing in the direction away from the uncertainties of the over-commercialized farm and toward the greater security of the well managed family farm."

This idealistic point of view toward agriculture is not new, especially among those looking at the industry more or less from the outside. To them the hope is in the family farm, well tilled; but the problem is not as simple as that. Indeed, it is difficult to generalize about agriculture in the United States. Probably the most distinctive characteristics of American agriculture are its high degree of regional specialization and its dependence on industry and on interregional and world trade for markets. These characteristics, coupled with the rapid mechanization and motorization of farming in large sections of the United States, are major factors moulding agriculture in this country. We should like to have seen these powerful forces analyzed in terms of an agricultural program. My guess is that in the broad deltas, prairies, and plains, the real heart of American agriculture, the sons and daughters accustomed to power machinery as they are will tend toward still larger-scale commercial farming.

Even now, as we are just coming out of the depression, in the areas adapted to the use of large scale motorized equipment, specialization is going forward at a great pace. Builders of power driven machinery are preparing for the greatest business in history. In view of these facts, is it not probable, in some regions at least, the trend away from specialized crop production is an evidence of weakness and not of strength?

Security of income is pointed out as one of the major objectives in agriculture. This objective is generally recognized. In the regions adapted to large-scale machine agriculture, however, they are seeking security in crop insurance rather than crop diversification, as the authors suggest.

Many others as well as the authors of this book seem to think that the farmers are somehow better citizens, especially the land owning farmers; that they are individualistic and independent. Will the facts bear this out? Have not some of the most radical movements, the most socialistic experiments in our history originated in the farming states? Even now, are not the farmers the most ardent supporters of the more or less socialistic experiments of the New Deal? Do not these expressions of discontent arise out of low incomes, rather than inhere in any type of occupation, and is not the surest way to have a contented, patriotic farm population to have farmers with larger incomes, which will probably mean greater emphasis on cash producing enterprises and a declining number of farms, other than "play" farms?

A. B. Cox

University of Texas

*Public Utility Regulation and the So-Called Sliding Scale*, by Irvin Bussing. Columbia Studies in History, Economics, and Public Law, No. 415. New York: Columbia University Press. 1936. 174 pp. \$2.75.

*Economics of Electric Distribution, Effects of Reduced Rates in T.V.A. Service Areas*, by Edward Falck. Chattanooga: Tennessee Valley Authority. May, 1936. 44 pp.

Public utility economics in this country has been so concerned with that segment of medieval scholasticism, the problem of valuation, that more important issues have been neglected. Recently, however, attention has been directed to the question of operating efficiency of public utility enterprises and of methods of securing the advantages of efficiency to consumers. It is too obvious to require restatement that existing techniques of regulation have little to contribute either to the stimulation of efficient methods of operation or to the determination of rates which shall no more than cover the costs of efficient operation. The sliding scale and Government "yardsticks" represent two different ways of dealing with problems which present regulatory methods neglect.

Mr. Bussing defines the sliding scale to include "any form of regulation in which the profit allowed increases or decreases in proportion as prices decrease or increase." Strictly speaking the sliding scale contemplates a standard return on the investment in a public utility enterprise with provision for increase if the enterprise lowers the price of its services and decrease if prices are raised. This method of rate regulation was first introduced in England where it was applied to gas companies and later to electricity enterprises. In this country it was used to regulate gas rates in Boston but was there abandoned, through no fault of the system itself, in 1926. At the present time the most important application of the sliding scale in the United States is in the regulation of the Potomac Electric Power Company in Washington.

It is clear that at best the sliding scale is a rather crude method of stimulating efficiency. It makes no distinction between the influences on costs and income within the control of management and those which lie outside. A reduction in the cost of supplying electricity caused by a fall in the price of labor and materials or by an increase in the population of the area supplied and consequently in the number of consumers will lead to higher returns under the sliding scale as effectively as will a reduction of costs brought about by more efficient management. Moreover the rewards of efficiency go directly to the stockholders and may or may not be shared with management.

Nor does the sliding scale avoid the difficulties of valuation which have plagued utility regulation in this country. The determination in Washington of the investment on which the Electric Company was to be entitled to earn a standard return resolved itself into a compromise between the actual investment figures of, roughly, \$24 millions, favored by the Commission, and the reproduction cost figures of \$44 millions favored by the company.



In periods of considerable price changes, furthermore, any sliding scale system breaks down as the War-time experience in England and in Boston shows.

Nevertheless the author concludes after a summary of the available evidence that the sliding scale represents an advance over present methods of regulation. This conclusion, however, is hardly capable of successful demonstration. The evidence consists largely of cases in which prices of utility services were lower under the sliding scale than under other methods of regulation or in which prices, as in Washington, fell rapidly after the introduction of the sliding scale. The Washington case is an interesting one. The author is well aware of the existence of other influences than the method of regulation on electrical rates, but no technique is presented, nor perhaps could one be devised, of isolating the influence of the sliding scale from other influences.

The book, though better on the American than on the English material, is a useful summary of experiences under a method of regulation which is likely to become of considerable importance in this country.

The T.V.A. pamphlet is concerned primarily with the elasticity of the domestic demand for electric power. Statistics are presented covering two years' experience in the twelve communities which by January 1, 1936, had begun to buy power from the Authority. Increase in consumption at the lower rates has been extraordinary, but again students are faced with the difficult problem of isolating the effect on consumption of rate reductions from other influences.

EDWARD S. MASON

Harvard University

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*Britain in Depression*, A Record of British Industries Since 1929, by a Research Committee of the Economic Science and Statistics Section of the British Association. London: Sir Isaac Pitman & Sons, Ltd. 1935. viii, 473 pp. \$3.00.

This book is the work of 22 collaborators under the chairmanship of Professor J. Harry Jones of the University of Leeds. Part I, General, contains three chapters: Introduction, or rather a summary, Currency and Banking, and Industrial Relations. Part II, Separate Industries, contains 21 chapters dealing with various industries, and one with national and local finance. The subtitle of the book indicates the principal aim of the endeavor, which was to provide a record of the depression while the events are still fresh in mind, but in almost all cases the discussion and data are extended backward to the early post-War years or to 1913.

That it is well to have such a record of British industry needs no emphasis here. Significant economic trends are apparent. The sickness that prevailed in Britain in many lines of industry during the 1920's is clearly revealed, and the world-wide collapse following 1929 is shown merely to have augmented the difficulties. The attempts to meet the problems in the many

lines of enterprise are well portrayed. These emphasize a major trend which has appeared in every capitalist country, namely, an increased degree of control both through cooperation among the various groups within an industry and through the agency of government. In agriculture, textiles, coal, and shipbuilding, for examples, many schemes have been tried designed to reduce capacity and control output. The underlying philosophy of these relatively new methods of control is not discussed in these pages. The authors content themselves with setting forth the record of what has been attempted or done. It may be observed, however, that from one angle the controls being set up may be regarded as concerted attempts to maintain scarcity and from another as a means of adjusting output to market through cooperation rather than by the old method of eliminating uneconomical plants through foreclosure and abandonment. Whatever may be the justification or lack of justification of these present-day methods, they clearly indicate that we have gone a long way from the stark individualism which prevailed when modern capitalism was in its infancy.

Another over-all picture which arises from a perusal of these pages is that of the delicacy of present day economic arrangements. The marked degree of interdependence, which to Britain is emphatically world-wide, makes the economic system as a whole highly susceptible to the disturbing influences of new methods, new products, or new sources of supply, and to changes in tariffs, monetary policies, wage or interest rates, taxation, etc. The juggler's feat of maintaining an economical balance among cost and selling price and market demand, which the business manager has always had to perform, is becoming increasingly difficult as the elements that affect them become more and more numerous. The British industrialists, who have a long record of resourcefulness, are being hard put to it since the close of the War, as this volume aptly shows. The measure of their success from now on will, we may hope, be embodied in other books such as this, fortified as it is, with a running account of events and copious data.

H. GORDON HAYES

Ohio State University

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*Operating Results of Department and Specialty Stores in 1934*, by Carl N. Schmalz. Harvard University Bureau of Business Research Bulletin No. 96. 1935. 42 pp. \$2.50.

*Operating Results of Department and Specialty Stores in 1935*, by Carl N. Schmalz. Harvard University Bureau of Business Research Bulletin No. 100. 1936. vi, 38 pp. \$2.50.

*Expenses and Profits of Limited Price Variety Chains in 1934*, by Stanley F. Teele. Harvard University Bureau of Business Research Bulletin No. 98. 1935. vi, 46 pp. \$1.00.

These annual publications, which have covered a period of six years in one case (variety chains) and eleven years in the other (department stores),

are of interest to statisticians for three reasons: (1) they deal with data covering approximately thirty-five per cent of the department store field and eighty-five per cent of the limited price variety field; (2) the use of well-planned reporting forms permits the assembling and treatment of the data in an authoritative fashion; and (3) they afford an excellent illustration of how the statistician can utilize his data in making constructive suggestions to the owners and managers of business enterprises. Chief interest here centers in the categories set up, the trends set forth, the statistical measures recommended for use in further studies, and the management suggestions made on the basis of the data. The year 1934 brought increased volume to all classes of stores studied, resulting in increased earnings and decreased expense percentages. Prior to 1933, larger stores showed larger earnings percentages than smaller stores. For 1933 and 1934 this profit differential was practically wiped out.

Department stores in 1935 apparently handled a volume of merchandise quite close to the peak volumes of 1929 and 1930. This increase in volume for the larger stores and skillful expense control restored the higher percentage earnings advantage over smaller stores wiped out in 1933 and 1934. It is apparent, therefore, that results in these two years were due to some temporary conditions. The authors suggest that the forces of recovery, considered by some to have benefited agricultural more than industrial areas, may have played some part. There is no doubt that large metropolitan stores, owing to location, financial status, and prestige policies were unable to make reductions in the same ratio as other stores. Volume was the only factor which could cure their expense ills.

All these publications admonish constant study of expense in a period of increasing volume. In many cases, it is known that price changes and "trading down" on the part of the buying public has resulted in large increases in physical volume with smaller increases in dollar volume. When dollar volume increases and expense percentages, particularly payroll percentages, decrease, management is apt to relax its vigilance with resulting disastrous results as regards profits at the end of the year. The data show that it cost the average large department store in 1934 roughly sixty cents to seventy-five cents to serve each customer. The data for 1935 contain approximately the same figures. In the 1935 report, specialty stores showed an average transaction cost of from \$1.462 to \$1.798 for stores with net sales of one to four million dollars. Although the average sale in such stores is much higher than in large department stores, the comparison of individual items of expense indicates that further savings in expense seem possible. In this connection, the recommendation is made for all types of large stores that surveys should be made to determine what special distributive functions are considered essential by customers and which could be dispensed with or operated on a service charge basis. In comparison, variety chains with a fifty-cent limit, where the average sale is approximately twenty cents, had an average transaction cost of seven cents in 1934. The 1934 study points out that there are possible future repercussions in the wide differen-

tial in costs per transaction between variety stores and department stores.

The authors advocate the wider use of number of transactions per salesperson, costs per transaction, and similar measures in order to narrow down the search for possible legitimate savings. Personal efficiency in both selling and non-selling departments is usually more easily obtained in smaller stores with owner management. Larger stores require statistical data in order to know where work must be done.

Although the differential profit enjoyed by the large department stores has been restored, competitive difficulties in other directions are on the horizon. Other large retail distributing agencies now have buying power and managerial strength equal to the largest department and specialty stores. The 1935 results indicate that management generally has done a satisfactory expense control job, but price level changes are disturbing the highly sensitive and complicated equilibrium between gross margin and the various items of expense. More attention must be given to external as well as internal factors, such as "price trends, general business conditions, political and governmental developments, and public attitude toward business and toward retailers." Increased managerial and public relations skill will be required to consolidate if not to improve the gains made in 1935.

There likewise seems to be an interesting relationship between cash and C.O.D. sales and profits. Those "goal" (most profitable) stores with larger percentages of profit had larger percentages of cash and C.O.D. sales. This result is of interest particularly in view of the many promotions and extensions of installment selling. These same stores, interestingly enough, likewise had higher rates of stock-turn, larger sales per employe, and larger sales per square foot, "all evidence of skillful management." Return goods, that bane of the merchant's existence, "tends to be larger, the larger the store," continuing the long-standing challenge to large-scale retail management to do something about the problem.

The study dealing with limited price variety chains shows conclusively that, despite increased tax burdens and dilution attributable to a marked increase in units inaugurated prior to the depression, this class of retail stores did an outstanding managerial job. On the average, profit was 15.19 per cent of net worth. "Clearly the variety chain trade was in the midst of a rapid expansion when the depression began and was unable to check that expansion until nearly two years of the depression had passed." Tenancy costs as well as taxes, in many cases discriminatory, were management problems that baffled solution. For sixteen identical variety chains, taxes per store (except on real estate and income) increased from \$605 in 1929 to \$1,360 in 1934.

Variety chains on the whole have been more successful in increasing gross margins than other types of retailers. "Just under thirty-seven cents of the consumer's dollar spent in variety chain stores was needed to cover expenses of the chains and to earn a profit in 1934." Although there were periods of rising prices, favorable to increases in gross margin, there was a general recession of prices continuing into 1935. Despite this price recession there

were increases in gross margins sufficient to cover other increased costs. The authors in this connection call attention to the possibility of future competitive difficulties should this condition be permitted to continue.

JAMES H. GREENE

Retail Merchants Association of Pittsburgh

*Insurance or Dole? The Adjustment of Unemployment Insurance to Economic and Social Facts in Great Britain*, by E. Wight Bakke. (Published by the Yale University Press for The Institute of Human Relations.) 1935. xiii, 280 pp. \$2.50.

*Unemployment Insurance* (Lessons from British Experience) New York: National Industrial Conference Board, Inc. 1934. viii, 30 pp. 50 cents.

The magnitude and complexity of the problem of administering unemployment insurance, as that form of protection is being developed under the Social Security Act, have made it increasingly evident that foreign experience must be fully utilized. The British experience is especially profitable for such exploitation, since it covers twenty-three years (the longest span of any such scheme), is rich in adjustment to changing economic and social conditions, and provides extensive records covering the various stages of its development.

Mr. Bakke's purpose in the present volume is to consider "fundamental problems of principle and policy connected with unemployment insurance which require all the light that experience can furnish." He seeks this objective through a critical and realistic scrutiny of outstanding administrative problems in Great Britain and by examining the more important modifications in the basic provisions of the British unemployment insurance legislation in relation to the economic and social realities which generated them. The analysis of administrative problems and statutory provisions is significant in itself, and many references to specific terms in the legislation and the resulting administrative procedures should be valuable for American readers. In addition, the volume is illuminating as a case history of social change; it traces the evolution of a new national attitude toward the protection of the unemployed. We are shown the steadily broadening front of the attack on unemployment in Great Britain, a development that is now also under way in this country.

When the unemployment insurance system of Great Britain was created in 1911, it gave limited recognition to the theory that unemployment could no longer be regarded as the fault of the individual. Since then the principle of national responsibility for the unemployed has become more deeply rooted with the result that the Unemployment Act of 1934 represents the government's acceptance of an obligation not merely to the *insured* but to all the *genuinely unemployed*. The early planners of the system could not fully foresee the nature and extent of the problem with which they were dealing. When, toward the end of the decade, the character of post-War unemploy-

ment was better understood, the original concept of unemployment benefit as a temporary stop-gap had to be abandoned. It had become clear that thousands of the jobless would never regain their former industrial status and that certain industrial areas were harnessed to labor surpluses which they would be powerless to move. The pressure of local authorities, which reacted to their problem in much the same way as the United States Conference of Mayors has here, was added to that of a strongly organized labor movement for assumption of greater responsibility by the national government. The need of providing jobs or maintenance was finally accepted as a proper debt of the country to its industrial army, even those members of it who were not qualified for benefit by the terms of the insurance legislation. Accordingly, in the 1934 law public assistance as a right, though determined by need and financed almost entirely by the national government, was made a supplement to the contributory insurance system.

But money payments, no matter how efficiently and generously administered, are far from being a complete solution. Measures are needed "to relate individual workers to society again as workers," and Mr. Bakke believes that "if the size of the problem increases very far beyond its present proportions society will realize what a disservice is done to social stability when a destitute leisure group is supported within a working population." Mr. Bakke indicates steps Great Britain has taken "beyond insurance" and suggests further alternatives. Certainly intelligent planning of an unemployment insurance system can no longer overlook the larger questions of emergency employment, re-training and relief.

The volume throws light on basic problems confronting American social security legislation. It points to the vital need of full understanding of the nature of our unemployment problem in order that our provision may be based on reality. The registration of the insured working population as a condition for unemployment insurance benefit has yielded Great Britain comprehensive, accurate, and nearly complete unemployment data on its working population. Only by corresponding organization and use of the public employment office system can adequate information be obtained in the United States. Unfortunately, in view of the Federal-state set-up of employment offices and unemployment insurance in this country and the consequent differences in administrative and statistical procedure, it will be years before we obtain an approximation of the British unemployment data. It must also be realized that a successful unemployment insurance scheme must be no less flexible than the British system has been; moreover it must be planned in close relationship with measures beyond insurance, for amid the uncertainty of modern industry a self-respecting citizen cannot fairly be treated like a pauper merely because he fails for statutory reasons to qualify for insurance benefits.

Incidentally, for those who insist on measuring the success of the British unemployment insurance system by financial criteria alone, it should be noted that at the end of 1935, after meeting all claims and paying the required installments on the debt to the Treasury, the fund had a surplus of

£21,449,810. For this reason benefits for dependents have been increased, and contributions for all three parties have been reduced.

The usefulness of the present volume is enhanced by appendices, which include a short history of the British unemployment insurance system, a brief summary of the present law and public assistance scheme, and some statistical material.

The purpose of the Conference Board's thirty-page pamphlet is to set forth the lessons from British experience with unemployment insurance. It summarizes the Acts of 1911 and 1920 and later extensions of the scheme, the report of the Royal Commission on Unemployment Insurance presented in November, 1932, and the Unemployment Act of 1934. The pamphlet is a convenient condensation of some of the principal pronouncements of the more important official documents on the subject.

In view of many assertions in this country that British employers are opposed to unemployment insurance, it may be noted that the National Confederation of Employers' Organizations in its recommendations to the Royal Commission said: "A compulsory system of contributory unemployment insurance should form a part of the industrial organization of the country."

In the page and a half entitled "Lessons from British Experience," most space is given to a suggestion that before any compulsory scheme of unemployment relief is adopted in the United States a fact-finding body should be established under Government auspices to make a thorough survey of the problem and to make recommendations for action by industry and by the legislatures. Great Britain had its Royal Commission on the Poor Laws and Relief of Distress, and no doubt the United States would have planned its legislation more effectively if some such body had executed a correspondingly comprehensive, thorough, and scientific investigation here. Concerning the statistics of unemployment, however, little is to be gained by any sudden sally into that field; unemployment insurance like many other new insurance forms will have to build up its factual basis as it operates.

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*Law and Labor Relations*, A Study of the Industrial Disputes Investigation Act of Canada, by B. M. Selekman. Business Research Studies No. 14, Volume XXIII, Number 1, Harvard University Graduate School of Business Administration, Bureau of Business Research, Boston. March, 1936. v, 65 pp. \$1.00.

The publication of this monograph, which presents the results of Mr. Selekman's latest research into and analysis and appraisal of the operation of the Canadian Industrial Disputes Investigation Act, is most timely; it deserves wide reading and careful study by all who have been concerned with the uncertainty of trends and the accelerated pace of changes in labor relations in the United States during recent years.

The timeliness and value of the work lies not so much in its bringing up to date the history of the Act and the developments in its operation and administration (covered in Chapter II); or in its well documented, fairly detailed presentation of cases and Board decisions on wages and hours (Chapter III) and on employees' representation and collective bargaining (Chapter IV). Rather is Mr. Selekman's study noteworthy because of its objective analysis of employers' and workers' changing attitudes toward the Act, with the reasons therefore (Chapter V); and because of its mature appraisal of significance of the Canadian experience for the United States (Chapter VI).

Mr. Selekman finds (1) that following the decision of the British Privy Council in 1925 declaring the Disputes Act *ultra vires* or "unconstitutional," the Act was reestablished, with the strong support of unions and without much opposition from employers, practically throughout Canada by both dominion and provincial laws; (2) that the Act has continued to enjoy the confidence and endorsement of unions (both minority and majority), of employers, and of the public; (3) that, following the first unfavorable reactions during the War period, the unions have come to support the Act, in spite of its infringement of their right to strike, because the administrators have, in the absence of any specific industrial code, gradually developed a labor common law or set of customs which have shown definite trends toward higher wages, fewer hours, better working conditions, and (in recent years) improved democratic status of labor in industry; (4) that employers, although less warm towards the Act because of its restrictions on freedom of management and favoring its operation mainly in public utilities, have not voiced strong opposition because the administrators have succeeded in reducing interruptions to production and have made for more orderly labor relations; (5) that the success of the Act and its administration has lain in the subordination of the Act's formal compulsions to the mediation process and to the force of public opinion.

In the light of the Canadian experience, Mr. Selekman is less than enthusiastic about the Wagner Labor Disputes Act in this country, with its semijudicial methods of promoting collective bargaining and labor democracy. He points out (1) that prior to the passage of the Wagner Act, unions had gradually succeeded in securing legislation (such as the Norris-La-Guardia Act) which removed some of the old common law disabilities and, in effect, made it easier for labor to help itself; (2) that nevertheless unions were still outlaws in American custom, i.e., in the minds of employers; (3) that the Wagner Act, instead of freeing labor and helping it to help itself, makes unions wards of the state and tries, in effect, to force employers to change their minds about unions; (4) that in the end employers' resistance may be heightened and industrial conflict may be fostered to such an extent that there may be successful moves for infringement on the right of labor to strike and help itself.

The attitude of most employers in this country may be deplored as short-sighted and antisocial. The attitude nevertheless is a fact to be reckoned with. Therefore, concludes Mr. Selekman, "the immediate task for govern-



ment would seem to be to free both sides so that they may develop as equals, rather than to introduce the principle of compulsory regulation in so delicate and fluid an area as industrial relationships in the United States today. That principle once established may be extended with dangerous possibilities to all concerned—trade unions and consumers, as well as employers.”

CARROLL R. DAUGHERTY

University of Pittsburgh

*Executive Guidance of Industrial Relations, An Analysis of the Experience of Twenty-Five Companies*, by C. Canby Balderston. Philadelphia: University of Pennsylvania Press. 1935. x, 435 pp. \$3.75.

Industrial relations policies have too frequently been lifted out of their setting and examined separately with regard to their adequacy in providing what the particular investigator or student believes to be a proper social or economic program of an employer for his employees. Professor Balderston places personnel policy where it belongs, as a part of a coordinated company policy which is controlled by many factors that are overlooked or disregarded by the casual and superficial investigator. The author sums up this dependence of industrial relations policy on the very practical considerations of business operation in these words: “No matter how well intended may be the efforts of a manager to put into effect an enlightened personnel program, he must bow to his master, economic forces. However high be his ideals, he cannot ignore profit stability, labor, overhead, and raw material costs, seasonal and cyclical variations in production, the traditions behind his industry, the financial strength of his company, and the myriad of other factors which cannot be measured.” This understanding statement of a truth often ignored is commended to those who glibly criticize the social attitude and shortcomings of business management and impugn its motives, with little understanding of the problems involved.

As a preliminary to his analysis, the author has studied intensively the industrial relations programs of twenty-five prominent American business concerns, most of which are closely identified with the development of modern personnel technique and a broader conception of management responsibility in the improvement of working conditions. He presents condensed summaries of the personnel policies of these companies, and these summaries in themselves constitute a valuable factual contribution to industrial relations literature. More original, however, is his analysis of the economic and personality factors which play so large a part in the determination of a company's personnel policy and the translation of this policy into actual everyday relationships.

What appears to be the author's main purpose—the construction of a standard of current good practice by which company executives may appraise their own personnel programs—is developed first by enumerating what he considers the essentials of a personnel program, and then by discussing the significance, purpose, and, in some cases, an illustrative exemplification of each item. These essentials as set forth by the author are: (1) The

prerequisites—fair wages and fair dealing; (2) the guidance of a definite policy; (3) the support of the chief executive and the proper place of personnel in the organization; (4) the regularization of employment; (5) unemployment reserves; (6) insurance against death, illness, and accidents; (7) pensions and annuities; (8) standardization of base rates and salaries; (9) financial and non-financial incentives; (10) systematic promotion policy and the auditing of its results; (11) selection, placement, and training; (12) reduction of accidents and illness; (13) joint relations—employee representation, union agreements.

In a number of cases these essentials are attitudes or policies rather than specific activities. This is as it should be, since the basic philosophy which underlies an industrial relations policy is far more significant than any catalogue of activities. Although the list of essentials may, in the aggregate, seem to constitute a rather ambitious standard to apply to the rank and file of business concerns, the author probably has in mind relatively large organizations, and, moreover, most of the items or policies are susceptible of adaptation to the size, resources, and scale of operation of any particular establishment. Again the emphasis is on the principle involved and not on any particular mechanism or technique. One is inclined to wish that Professor Balderston's objective analysis of the fundamentals of a well-considered and adequate personnel policy could be made available in a condensed, briefer publication to encourage its study by executives who instinctively shy away from what, to them, has the appearance of a formidable volume.

H. F. BROWNE

National Industrial Conference Board

*Labor Fact Book* No. III, Labor Research Association. New York: International Publishers. 1936. 223 pages. \$2.00.

The *Labor Fact Book* series of the Labor Research Association possesses two virtues not commonly found in "books of facts": Within a compass of a little more than 200 pages, these books present in an organized fashion a compendium of current politico-economic facts for which one would otherwise need to make search in many widely scattered sources; the "facts" are not mere statistical tabulations but running commentaries for the instruction and the enlightenment of those who wish to see these facts in the light of the interests of labor. The *Labor Fact Books*, according to the authors, are "prepared for the use of workers, farmers, students of economics and sociology, writers, speakers, organizers and all others engaged in any form of activity in the labor movement in its broadest sense." In our preoccupation with the search and collection of original data in social economics and particularly in our technical treatment of such data, we often forget and overlook the very significant fact that behind these data lie human values. Our failure to note these human implications becomes especially deplorable in times of social stress. The *Labor Fact Books* emphasize precisely these underlying values. They translate the facts and figures into their meaning to

man,—to labor, and show how they impinge on man's efforts to improve his lot today and tomorrow.

Labor Fact Book No. III deviates from its predecessors<sup>1</sup> in its more extended treatment of "Farmers and Farm Workers" (Chapter VII) and in the introduction into the purview of "labor," of facts pertaining to the place of the "Professional Workers" (Chapter VI) in the industrial economy of the day. In the chapter on "Farmers and Farm Workers," the Labor Research Association reminds us that between 1933 and 1935 "over 800,000 American farmers lost their farms through foreclosures" and that in the spring of 1935 "over 700,000 farmers and their families, together with 600,000 agricultural workers, were on Federal relief rolls"; that nearly one-third of the increase in the farmer's cash income between 1933 and 1934 "came from the larger sales of cattle and sheep which had to be sacrificed because of the drought." Under the caption "Who Buys the Farms," it is pointed out that at the beginning of 1935 insurance companies held 16 per cent of the farm mortgages in comparison with 23 per cent at the beginning of 1928, and the commercial banks held 6 per cent in comparison with 11 per cent on the corresponding dates. On the other hand, the Federal Land Banks and the Land Bank Commissioner held one-third of the farm mortgage debt in the spring of 1935 in comparison with 12 per cent in the beginning of 1928. "These facts clearly reflect the Government's course in bailing out the mortgage holders," the authors comment. The section on "Agricultural Workers" is particularly enlightening, especially where it deals with the strikes of farm workers and the organizational strength of share-croppers and tenant unions.

The chapter on "Professional Workers" is unique in that for the first time facts are brought together pertaining to the organizational strength of professional workers as trade unionists. Some 250,000 professional workers, we are told, are now organized in trade unions and other organizations with acknowledged protective purposes. Eight pages of small type give brief sketches of the organizational history and strength of a number of professions, including musicians, teachers, journalists, and librarians. Informative is the sketch of the organization and purpose of the Inter-Professional Association and the role it is assuming in giving unified direction to the growing efforts of the workers in the professions in making common cause with labor in industry to the end of securing social legislation for the protection and betterment of the wage as well as the salaried workers, laying special emphasis on the enactment of an all-inclusive program of social insurance.

A listing of the activities of almost two score of fascist and near-fascist organizations operating in this country and a table on "Killings of Workers" (pages 172-178) and another on notable strikes of 1934-1935 (pages 72-78) point to the emphasis placed by the authors on the need for a growing awareness of labor of the struggles it faces to maintain its own freedom of action as well as the fight which it must carry on for the protection of the democratic rights of the American people in general.

JOSEPH M. GILLMAN

Washington, D. C.

<sup>1</sup> A review of *Labor Fact Book No. II* appeared in this JOURNAL for March, 1935.

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## CONTENTS

Karl Pearson, 1857-1936. By RAYMOND PEARL . . . . .	653
Statistics on Copper in the United States. By Y. S. LEONG . . . . .	665
The Probability Distribution of Protection Test Results. By HUGO MUENCH . . . . .	677
The Improvement of Statistical Techniques in Biology. By GEORGE W. SNEDECOR . . . . .	690
Industry Statistics in Marketing Management. By S. J. KENNEDY . . . . .	702
Development of the Postal Savings System. By LOUISE SISSMAN . . . . .	708
The New System of Population Accounting in the Netherlands. By Dr. H. W. METHORST . . . . .	719

## NOTES

A Test for the Goodness of Fit of a Curve Graduated to a Series of Observed Means. By JOSEPH BERKSON . . . . .	723
The Index Numbers A.M. <sub>I</sub> and A.M. <sub>II</sub> . By GEORGE H. EVANS, JR. . . . .	726
The Analysis of Regression in Subsets of Variables. By FREDERICK V. WAUGH . . . . .	729
A Trend Line for Growth Series, Further Remarks. By NORRIS O. JOHNSON . . . . .	731
The Purpose and Progress of the Attorney General's Survey of Release Procedures. By BARKEV S. SANDERS . . . . .	732
Training Field Agents in the Bureau of Labor Statistics. By JACOB PERLMAN . . . . .	735
A Coöperative Arrangement for General Relief Statistics . . . . .	736
Progress of Work in the Census Bureau . . . . .	737
Chapter Activities . . . . .	739
Statistical News and Notes: Board of Governors of the Federal Reserve System (740); Farm Credit Administration (740); Bureau of Agricultural Economics (740); The Federal Trade Commission (741); Bureau of Foreign and Domestic Commerce (742); Bureau of Labor Statistics (744); United States Employment Service (745); Children's Bureau (745); Women's Bureau (746); U. S. Bureau of Mines (747); Office of Education (747); Division of Research, Statistics and Records, Works Progress Administration (747); National Research Project, Works Progress Administration (750); Division of Social Research, Works Progress Administration (751); Division of Placement and Unemployment Insurance, New York State Department of Labor (752); Harvard University (752); National Bureau of Economic Research (753); Wharton School of Finance and Commerce, University of Pennsylvania (753); National Industrial Conference Board (754).	
New Members . . . . .	755

## REVIEWS

ABRAMSON, VICTOR. See Lyon, Leverett S.	
ADAMS, ARTHUR B. <i>National Economic Security</i> . Frederic Dewhurst . . . . .	785
BAKEWELL, PAUL, JR. <i>Past and Present Facts about Money in the United States</i> . W. A. Morton . . . . .	802

Continued on next page

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# REVIEWS—(Continued)

BEACH, W. EDWARDS. <i>British International Gold Movements and Banking Policy. 1881-1913.</i> Melchior Palyi	783
BLAISDELL, WILLIAM M. <i>Financing Security Trading.</i> Jules I. Bogen	809
BOYD, EDITH. <i>The Growth of the Surface Area of the Human Body.</i> Eugene F. Du Bois	765
BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. <i>Mathematical Tables, Volume V.</i> John D. Elder	760
BURNS, ARTHUR ROBERT. <i>The Decline of Competition.</i> L. A. Morrison	776
CASSEL, GUSTAV. <i>The Downfall of the Gold Standard.</i> G. F. Warren	803
CHAPMAN, HERMAN HOLLIS. <i>Iron and Steel Companies in Years of Prosperity and Depression.</i> Paul L. Howell	809
CHAPMAN, JOHN M. See Willis, H. Parker.	
CRUM, WILLIAM LEONARD. <i>The Distribution of Wealth: A Factual Survey Based Upon Federal Estate-Tax Returns.</i> Ralph C. Epstein	770
DANTYSZ, E. S. <i>Contribution a l'étude des fortunes privées d'après les déclarations de succession.</i> W. L. Crum	767
DAVIE, MAURICE R. <i>World Immigration, with Special Reference to the United States.</i> Joseph M. Gillman	789
DAVIS, HAROLD T. <i>Tables of the Higher Mathematical Functions, Vol. II.</i> John D. Elder	759
DAWSON, RALEIGH W. <i>Consumer Market Data Handbook: 1936.</i> Paul W. Stewart	788
EDIN, KARL ARVID and HUTCHINSON, EDWARD P. <i>Studies of Differential Fertility in Sweden.</i> Clyde V. Kiser	762
EZEKIEL, MORDECAI. <i>\$2500 a Year.</i> George Soule	787
FAIRCHILD, FRED ROGERS. <i>Forest Taxation in the United States.</i> John Ise	812
FREEMAN, HARRY. <i>Examples in Finite Differences, Calculus, and Probability.</i> Thornton C. Fry	757
GLOVER, JAMES W. See Menge, Walter O.	
HAMILTON, EARL J. <i>Money, Prices, and Wages in Valencia, Aragon, and Navarre, 1351-1500.</i> F. A. Pearson	800
HUNT, BISHOP CARLETON. <i>The Development of the Business Corporation in England 1800-1867.</i> Nathan Isaacs	774
HUTCHINSON, EDWARD P. See Edin, Karl Arvid.	
INSTITUTE OF HUMAN RELATIONS. <i>A Handbook of Social Statistics of New Haven, Connecticut.</i> George A. Lundberg	819
KEYNES, JOHN MAYNARD. <i>The General Theory of Employment, Interest and Money.</i> Joseph A. Schumpeter	791
KRAMER, EDNA E. <i>A First Course in Educational Statistics.</i> Robert V. Young	766
LYON, LEVERETT S. and ABRAMSON, VICTOR. <i>The Economics of Open Price Systems.</i> Arthur Robert Burns	779
MCKEE, SAMUEL, JR. <i>Labor in Colonial New York, 1664-1776.</i> Broadus Mitchell	811
MAY, GEORGE OLIVER. <i>Twenty-Five Years of Accounting Responsibility, 1911-1936.</i> Roy B. Kester	772
MEANS, GARDINER C. See Ware, Caroline F.	
MENGE, WALTER O. and GLOVER, JAMES W. <i>An Introduction to the Mathematics of Life Insurance.</i> James S. Elston	766
NATIONAL INDUSTRIAL CONFERENCE BOARD, INC. <i>Vacations with Pay for Wage Earners; Wanted: Skilled Labor; Financial Incentives—A Study of Methods for Stimulating Achievement in Industry; Women Workers and Labor Supply; and What Employers Are Doing for Employees—A Survey of Voluntary Activities for Improvement of Working Conditions in American Business Concerns.</i> C. Canby Balderston	813
NETTELS, CURTIS PUTNAM. <i>The Money Supply of the American Colonies before 1720.</i> Earl J. Hamilton	798
NEW YORK STATE DEPARTMENT OF SOCIAL WELFARE. <i>Handbook for the Collection and Tabulation of Statistical Information about Children in Foster Care by the New York State Department of Social Welfare; Handbook for the Collection and Tabulation of Statistical Information from Private Institutions for the Care of the Aged in the State of New York; and Handbook for Statistics of Mothers' Allowances.</i> Marc J. Feldstein	820

# REVIEWS—(Continued)

NEYMAN, J. and PEARSON, E. S. (Editors.) <i>Statistical Research Memoirs</i> , Volume 1. S. S. Wilks . . . . .	760
PEARSON, FRANK A. See Warren, George F.	
PEARSON, E. S. See Neyman, J.	
RODKEY, ROBERT G. <i>State Bank Failures in Michigan</i> . Wilbert G. Fritz	806
STANFORD UNIVERSITY. <i>Wheat Studies of the Food Research Institute</i> . Roland S. Vaile . . . . .	815
SWEENEY, HENRY W. <i>Stabilized Accounting</i> . T. H. Sanders . . . . .	771
TAGGART, HERBERT F. <i>Minimum Prices under the NRA</i> . Leverett S. Lyon	780
VON MISES, RICHARD. <i>Wahrscheinlichkeit, Statistik und Wahrheit</i> . Edward L. Dodd . . . . .	758
WARE, CAROLINE F. and MEANS, GARDINER C. <i>The Modern Economy in Action</i> . L. A. Morrison . . . . .	776
WARREN, GEORGE F. and PEARSON, FRANK A. <i>Gold and Prices</i> . George K. McCabe . . . . .	805
WILLIS, H. PARKER and CHAPMAN, JOHN M. <i>The Economics of Inflation, The Basis of Contemporary American Monetary Policy</i> . Robert W. Burgess . . . . .	795



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KARL PEARSON, 1857-1936

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*Johns Hopkins University*

Animo vidit, ingenio complexus est, eloquentia  
illuminavit. Velleius Paterculus.

## I

THE UNROLLING of the long scroll of human history has shown nothing more clearly than that the number of individuals is in total extremely small who by the sheer power of their own intellects, unaided by position or circumstance, have been able to influence appreciably the modes of human thinking. Since the beginning of recorded history the world has held a lot of intelligent and shrewd men, each doing his life's work well, who passed on in the end without leaving a discernible trace upon the rest of humanity that they had individually ever lived. Whenever human thought or outlook has altered in its course, by ever so little, it has always been because some extraordinary individual—in the literal sense of the words—has changed it, in a wider or narrower field as the case may have been. Both quantitatively and qualitatively such individuals have played a rôle in human biology analogous to that of catalyzers in chemistry. They make things go differently.

Karl Pearson was one of these extraordinary individuals. In literal truth "his intelligence saw a problem, his genius encompassed it, and his exposition illuminated it," to paraphrase what Velleius said of Cicero. Because he lived and worked virtually every branch of science, pure and applied, is different today from what it was when he began. The differences are permanent and irrevocable. Biology, anthropology, psychology, agriculture, physics, mathematics, engineering, education—to take only the more conspicuous examples—will bear in perpetuity the indelible impress of Karl Pearson's mind. His work is ended, to be



sure, while science is deathless and will continue to move on. His thumb-prints on its pages will grow dimmer and be blurred with the passage of time. But he made it go a different way, and science never retraces its steps.

How came it about? In what way was such an effect produced. It was not by the route of great discovery, because Karl Pearson never made a particularly important discovery, great or small, as a review of his life work plainly shows. What he did do was the thing that Pawlow long ago said was really the most important thing a scientific man could ever do, namely to develop a new technique or methodology in some branch of science—this on the ground that substantially all the real advances in science have been the resultants of new techniques, mental or material or both. Precisely this is what Pearson did. Out of well known mathematical principles and procedures, each separately quite devoid of novelty, he constructed a new statistical calculus; made the world for the first time truly conscious that some sort of a logically coherent statistical calculus was indispensable for the sound prosecution of the enterprise of science; and demonstrated by his works that his was the best one presently at hand. The results were far-reaching in the way that has been indicated. Every stage in the progression met vigorous and sometimes bitter opposition from lesser minds, as is the normal way of mankind with new ideas of whatever sort. Pearson, being a fighting kind of man, fought for his ideas. But all his fighting, splendid as some of it was, had not the very smallest influence on the outcome, as we can now see. Humanly he wanted to see his ideas triumph. But ideas rarely if ever have really "triumphed." Theirs is not so crass a way. If they are good and useful they get *used* more and more. Just this has happened to the *corpus* of Pearsonian statistical ideas. Every college in every land teaches them. Every laboratory uses them. It would be pointless to say that Pearson's fighting was in vain; it just was unnecessary.

## II

Karl Pearson was born in London, March 27, 1857, and died suddenly on April 27, 1936. His father William Pearson was a Yorkshireman, who became a distinguished barrister and King's Counsel. The Pearsons were stout folk, with an almost infinite capacity for concentrated hard work. Karl Pearson's association with University College was nearly lifelong, for as a boy he was educated at University College School, and at the early age of 27 was appointed to the Professorship of Applied Mathematics and Mechanics in the College. From then on to a few months before his death his life work was done

within the walls of University College, London, with only summer vacation interludes in the country cottage where the work went on just the same, and where the monumental "Life of Francis Galton" was mainly written.

In 1875, at the age of 18, after a year spent for reasons of health with a private tutor, Pearson entered King's College, Cambridge, as a scholar, and was graduated B.A. (Mathematical Tripos, 3rd Wrangler) in 1879. He was elected a fellow of the College the following year, and held the fellowship until 1886. It was his original intention to follow in his father's footsteps and make the law his profession. To this end he was called to the Bar in the Inner Temple in 1882. But circumstances and a rapidly developing disinclination to the practice of law as a mechanism for earning a living altered this plan, and substituted for it the academic life, for which he was so fundamentally suited.

Pearson thoroughly enjoyed his undergraduate life at Cambridge. Shortly before his death he said of it: "I want to point out that in the Old Tripos Days at Cambridge it was possible for an individual thoroughly to enjoy his undergraduate career, to read mathematics outside the Tripos range, and a good many other subjects as well, to find 'coaches' who led him on and grew to be friends, to find college authorities who on the whole had some sense of humor and were not wholly upset by his want of respect for the 'conventions,' and lastly, and best of all, to have no vampire Tripos conception hanging over him for more than three years. There was pleasure in the friendships, there was pleasure in the fights, there was pleasure in the coaches' teaching, there was pleasure in searching for new lights as well in mathematics as in philosophy and religion. I think I carried away from Cambridge my full share of the benefits it can bring to any of its sons."

Among the great men with whom he had more or less close association in the Cambridge days, and by whom his outlook in after life was in some degree influenced were Edward John Routh, perhaps the greatest mathematical "coach" Cambridge has ever seen, who trained something over 700 pupils of whom 500 in round numbers became wranglers, including the senior wranglers for the twenty-two consecutive years 1861-1882; Munro, the great classical scholar, whose edition of Lucretius is still unrivalled, and who entreated Karl Pearson "with almost the tenderness of a father to write a few Latin verses"; Stokes, the mathematical physicist and pioneer in spectrum analysis, who was in K. P.'s own mature opinion the best lecturer (with one exception, Quincke) he ever encountered; Adams, the co-discoverer of Neptune, who with K. P. constituted the sole auditors of a course of lectures on Dante, taken as a diversion from mathematical reading; Cayley, justly

regarded as one of the greatest mathematicians of all times, and certainly one of the most prolific, who served port at his Smith's Prize Examination, and remarked a few days later that "there was only one man [K. P.] who appeared to have thoroughly enjoyed his paper—it was the one man who [drank and] thoroughly enjoyed his port"; Clerk Maxwell, brilliant star in the galaxy of mathematical physics, whom Pearson, in the luncheon interval of a Smith's Prize Examination, of all inopportune times, "aroused to the highest pitch of anger" by speaking disrespectfully of Noah and his flood; and Isaac Todhunter, whose posthumous *History of the Theory of Elasticity* Pearson completed and saw through the press, chosen as a very young man for the task because of an original proof he had given in an examination paper in answer to a question on the flexure of prisms.

If Pearson thoroughly enjoyed his undergraduate days, the first few years of his fellowship with its complete freedom from any sort of responsibility or duty—including freedom to go where he pleased and do what he liked—formed a fitting climax. I still recall vividly the gleam in his eye and the joy in his face when he told me many years ago about his life in those days. Rejoicing in his liberation he first went off to Germany. "In Heidelberg I studied Physics under Quincke, but also Metaphysics under Kuno Fischer. In Berlin I studied Roman Law under Bruns and Mommsen, but attended the lectures of Du Bois Reymond on Darwinism. Back at Cambridge I worked in the engineering shops but drew up the schedule in Mittel- and Althochdeutsch for the Mediaeval Languages Tripos." But even such an exhibition of range of interest and versatility of talent is only a part of the story. The life in Germany involved more than university lectures. He lived with the people—*Bauern* as well as *Professoren*—soaking in like a blotter the fundamentals of an alien culture. At the same time he was eclectically playing with the flood of ideas welling up in a yeasty young head; ideas ranging over literature, art, philology, folk-lore, anthropology, religion, sociology, history and politics.

As tangible major products of this fellowship period, though in part actually published after its conclusion, may fairly be regarded the three books that first brought Pearson considerable public notice—*The Grammar of Science*, *The Ethic of Freethought*, and *The Chances of Death*—since in whole or in part they were the outcome of interests and activities dominant during that period.

*The Grammar of Science* (1892 and later editions) was a remarkable achievement, by any standards of time or place. For a generation it had a great and far-reaching influence, particularly upon young men embarking on scientific careers but also upon other alert minds. Nowa-

days it is apparently little read. The world has moved on. Some of the very characteristics of its literary structure that gave it usefulness and influence when it first appeared, and in its earlier revisions, automatically dated it and made a certain, though longish, ephemerality inevitable. But in the welter of modern physical mysticism, rapidly spreading over into biology, it will do no young man any harm to read the second edition of *The Grammar of Science*. For it taught, as its central and imperishable theme a truth that will never die and that each new generation of oncoming workers in science has to learn, that science can never explain why but only describe how.

*The Ethic of Freethought* and *The Chances of Death* were definitely aimed at a popular audience. Both were collections of essays, lectures, and public addresses. It is safe to say that *The Ethic of Freethought* is practically forgotten today. It contains the first fresh and more youthful boiling over of many of the ideas that K. P. later discussed in greater detail and with riper wisdom at various times and places. It was first issued in 1887, but dated 1888, and a second revised edition appeared in 1901. The book falls into three sections: Freethought; History; Sociology. It opens with the following statement: "I set out from the standpoint that the mission of Freethought is no longer to batter down old faiths; that has been long ago effectively accomplished, and I, for one, am ready to put a fence round the ruins, that they may be preserved from desecration and serve as a landmark," and then goes on to say: "the first five papers of this volume endeavour to formulate the opinions which a rational being of today may hold with regard to the physical and intellectual worlds. They advocate—with what measure of success I must leave the reader to judge—a rational enthusiasm and a rational basis of morals. They insist on the almost sacred nature of doubt, and at the same time emphasize scientific and historical study as the sole path to knowledge, the only safe guide to right action. The Freethinker's position differs to some extent from that of the Agnostic. While the latter asserts that some questions lie beyond man's power of solution, the former contents himself with the statement that on these points he does not know at present, but that, looking to the past, he can set no limit to the knowledge of the future. He has faith in the steady investigation of successive generations solving most problems, and meanwhile he will allow no myth to screen his ignorance. The Freethinker is not an Atheist, but he vigorously denies the possibility of any god hitherto put forward, because the idea of one and all of them by contradicting some law of thought involves an absurdity. He further considers that in the present state of our knowledge and of our mental development, the attempt to create

self-consistent gods is doomed to failure. It is mere waste of intellectual energy."

Here plainly is revealed the pattern of the philosophy that motivated and guided the man's life work, in all its major features. Realistically viewed it is the expression of the complete equivalent of a religious faith; faith in the enduring virtues and values of science, of history, of scepticism, and of curiosity—the desire to know—as wellsprings of revelation for the conduct and meaning of human life. This way of putting the matter is not mere rhetoric. Spiritually there is an extremely close and deep-rooted parallelism between the manner in which Karl Pearson actually conducted his own life and the way that a few persons of really great and abiding religious faith lived theirs.

In *The Chances of Death and Other Studies in Evolution* published in 1897 the statistician first emerges to public view. The basic significance of this book in marking a point in its author's development seems to me to be two-fold. In the first place the Cambridge mathematical training is put to useful work. The rich intellectual pudding that has been in the confecting all these years has jelled into the general pattern that is to be dominant to the end. In the second place, an additional major tenet of the author's faith makes its now well-considered appearance. "He believes that the sympathetic reader will find in one and all the essays the fundamental note of the author's thought, namely: the endeavour to see all phenomena, physical and social, as a connected growth, and describe them as such in the briefest formula possible. Without asserting that evolution can explain anything, but accepting it as a most invaluable formula for describing the sequences of phenomena as we have experience of them, the rationalist has at present a quite impregnable stronghold against reactionaries of every type. He is not called upon to show that evolution explains the universe; he may content himself with the simple challenge to his critics to produce any other formula so useful in describing our experience of the concatenation of phenomena—any other formula which so markedly economizes thought, or, differently expressed, which so amply fulfills the purport of science."

*The Chances of Death* appeared while I was an undergraduate in college. Heterogeneous as it really is in content, in spite of K. P.'s earnest if not wholly convincing plea of unity, it stirred my imagination and enthusiasm as nothing ever had that I had read up to that time. It plainly was not a great book in the sense that *The Origin of Species* was great. But it *was* great in another way. It was alive, hearty, vigorous. It was about a lot of things you could do something about. It in-

spired curiosity and action, rather than awe. To a callow budding biologist, very young and very ignorant, it opened enchanting vistas of possibilities in biological thinking and research before undreamed of. It was wonderful. And as presently became apparent the Dartmouth sophomore was not the only one who had seen the vision and been stirred by what Karl Pearson was up to. Biometry had in fact been born, and was yelling and kicking as a lusty infant should.

### III

In the technical journal of an association of professional statisticians it would plainly be supererogation to attempt to review in any detail the great volume of Karl Pearson's statistical contributions. In fact even such a possibility is precluded because in mere bulk they are unparalleled in the history of this branch of science. The old quill pens on the study and office desks—relics of Inner Temple habituation to be occasionally but never wholly succeeded in later years by a very soft nibbed fountain pen—scratched out a prodigious number of words and figures in that characteristically forceful and clear if not exactly beautiful long-hand. Naturally some of these papers were more important than others. Some had mistakes in them. But with whatever shortcomings that there may have been duly entered in the ledger, on the balance few men who have filled so many pages in the story of science have left so clean, so worthy, and so honorable a record.

Technically Pearson's most important contributions to *statistical theory* fall in four categories. They are:

1. The method of moments first employed simply as a device for curve fitting, but in the end to have far-reaching consequences for the development of general statistical theory.
2. The system of skew frequency curves, as a technique for mathematically describing natural phenomena that individually vary.
3. The development of the theory of correlation and its application to the problems of heredity and evolution.
4. The  $\chi^2$  test for goodness of fit of theory to observations, coupled with the mathematical, logical, and statistical consequences and applications that grew out of it.

His most important *practical contributions* to the progress of statistical sciences were:

1. Teaching a long succession of students from many lands, who preached "the gospel to the whole creation," and included in their number such major figures as Yule and Greenwood.
2. The founding of *Biometrika* in 1900 and its editing for 36 years.

Others have been associated—Galton and Weldon as co-founders and various others as assisting editors—but the real genius of the enterprise has always been Pearson.

3. The *Tables for Biometricians and Statisticians*, and the *Tracts for Computers*, and other mathematical tables that cannot be listed for want of space.

The major contributions to *biology and eugenics* were:

1. The long series of memoirs on variation, heredity, and fertility that may perhaps justly be said to have culminated in the logically and mathematically rounded completion of Galton's Theory of Ancestral Inheritance.

2. The *Treasury of Human Inheritance*.

3. The founding and editing until retirement from the Galton professorship of *The Annals of Eugenics*.

These ten items of major achievement constitute a remarkable record even for a long life. Even so the list omits a host of interesting and significant by-products and digressions.

Leaving details and mere trivialities out of account the principal respects in which Pearson's work has led to controversy are two; one basically logico-mathematical, the other biological. The attempt will be made to show, necessarily briefly, that both really grounded themselves upon the same philosophical issue, in respect of which it seems fair to say on the evidence that K. P.'s opponents seem never to have quite clearly grasped his position or appreciated its fundamental cogency; also, on the biological issue at least, it appears that from his side he never quite gave the devil his due.

The first of the two matters referred to concerns the significance and usefulness of the system of skew frequency curves, and, by derivation, of curve-fitting in general. This has not been so much a subject of overt public controversy as of a sort of "whispering campaign," particularly in this country and England, in some part based upon honest doubt and uncertainty, but in part upon a vicious intent to defame a great man. The second matter concerns the mutual relationships of the Galtonian and Mendelian outlooks on the problems of inheritance. Here the controversy was open and violent.

In both cases the issue was similar; it was the age-old battle between the realist and the sentimentalist, here arrayed between the man who holds that science can never do more than *describe* how events have occurred, and him who wishfully hopes that science may somehow *explain* events. To Pearson the equation of a curve that fitted a wide range of natural phenomena was a convenient and useful short-hand description of certain characteristics of those phenomena *et praeeterea*

*nihil*. For a particular curve he might know a lot or a little as the case might be about the relations between the mathematical constants and the physical sequences relative to the phenomena, commonly generically called causation. In the one case the curve would be conveniently denominated rational, in the other empirical. But I think that K. P. was not greatly impressed by this verbal distinction, having the faith that with the passage of time and the fullness of investigation we should ultimately come to know a lot about many things of which we now know only a little. A few months before his death he said (*Nature*, 136, 297, 1935): "From my point of view the tests [of the  $P$ ,  $\chi^2$  type] are used to ascertain whether a reasonable *graduation* curve has been achieved, not to assess whether one or another hypothesis is true or false. If we narrow ourselves down to asking whether a normal curve will reasonably *graduate* the material and find it does, are we to follow it up by asserting that either sample or parent-population follows a normal distribution? I should say: Certainly *not*. I have never found a normal curve fit anything if there are enough observations! The astronomical data provided to prove that errors of observation follow normal curves are pitifully scanty, and if proper tests are applied usually show that they do not! The fact is that all these descriptions by mathematical curves in no case represent 'natural laws.' They have nothing in this sense to do with 'hypothesis' or 'reverse of hypothesis.' They are merely *graduation curves*, mathematical constructs to describe more or less accurately what we have observed.

"The reader will ask: 'But if they do not represent laws of Nature, what is the value of graduation curves?' He might as well ask what is the value of scientific investigations! A good graduation curve—that is, one with an acceptable probability—is the only form of 'natural law,' which the scientific worker, be he astronomer, physicist or statistician, can construct. Nothing prevents its being replaced by a better graduation; and ever bettering graduation is the history of science.

"What is the use of good graduation curves? Ask the actuary! Such curves enable a mass of details to be summed up with reasonable probability in the knowledge of a few constants, and from these constants we obtain new knowledge of the properties of the mass. Take only the importance of a life table graduated by the Makeham-Gompertz curve and consider, what new knowledge flows from it. But after all, it is only a graduation curve and it is open to anyone to find a better one!"

The essence of the controversy over heredity was found in the same philosophical point. In Pearson's view the sound way to investigate heredity was to describe and measure the kind and degree of somatic



resemblances between individuals and their kin, without regard to any theory as to the biological or physical causation of such likenesses as might be found. He justly held that whenever any adequate biological theory of heredity appeared it could not contradict, but must in fact encompass within its range the biometric findings. Mendelian experimentation demonstrated a germinal mechanism lying behind the somatic expression of hereditary differences, and established the biological bases of genetic causation. Nothing in this could endanger or even disturb the soundness of Pearson's underlying philosophical position, but in the early heyday of Mendel's rediscovered work, K. P., doubtless influenced by Weldon, unwisely questioned the accuracy and validity of the experimental results that the Mendelian experimenters were getting, and of which he had a somewhat less than adequate first-hand knowledge. In consequence his influence with the biologists was for a time weakened. With similar lack of soberly poised judgment the Mendelists endeavoured to throw to the wolves the whole body of observed biometric facts about heredity. But as was bound to be the case all this was only a passing phase. Pearson came quickly to see the importance of Mendelian discoveries, and indeed himself made important contributions to Mendelian theory by showing mathematically that on simple and reasonable assumptions regarding the gene-soma nexus Mendel's laws led to the expectation in populations of precisely the results in ancestral inheritance that had been biometrically described. Like many another example of human frailty the whole episode was deplorable. It did not really advance science in the least. On the contrary it is probable that genetics would be in a more advanced and generally sounder position today than it is if Karl Pearson and the great Mendelian leaders of the time had been able to work cordially and sympathetically together.

## IV

In conclusion, what of the man? That his was one of the greatest intellects of his times admits of no reasoned doubt. But intellectual power alone does not make a man. What he uses it for, and how he lives with so precious and noble an endowment are the questions that must at the end be appraised. In the final analysis I think that Karl Pearson was primarily a great teacher. The whole pattern of his life and living set that purpose and motive above everything else. This may seem a strange thing to say of a man who published in his life time a total bulk of first-rate original research only rarely equalled in the whole history of science. But let us examine the point. In relation to his own personal research he always thought of biometric and sta-

tistical methods, I am sure, merely as means to an end—tools of a trade—that end being the discovery of new laws and principles, particularly in the biological fields of evolution and heredity. Furthermore, with a touch of that self-delusion from which even the great never seem altogether to escape, I am sure that he honestly believed that he was chiefly devoting his own life to making such applications. But actually, as the record plainly shows, and particularly the grand record left in the pages of *Biometrika*, it is evident that as the years went on a larger and larger portion of his energies went into the developing, broadening, and deepening of the mathematical theory and methodology of biometry and statistics, while more and more the applications to the solving of particular objective biological problems were left to his assistants and pupils.

But precisely this is *teaching*—teaching not merely the pupils in the classroom, but teaching “all creation” in the biblical phrase. In short it seems to me that K. P. was after all really more interested in showing mankind how to go about unearthing the secrets of Nature than he was in digging them out himself. Herein, I think, did he most widely differ from Darwin, Galton, and Pasteur, with whom he may justly be compared as to inherent intellectual powers. No one of them was the teacher in the sense of being primarily motivated to train men in the way to do things for their own advancement. Each, on the contrary, was primarily a discoverer, moved by a consuming curiosity to find out about natural phenomena without much regard for or interest in the methodology involved, for no other conscious reason than the satisfying of that curiosity.

As a teacher Pearson was superb. He had the rare gift of complete clarity, coupled with an understanding appreciation of what the pupil was going to find difficult, and a willingness to take the pains in advance to eviscerate the point completely by numerical example and in other ways, so that anyone could understand the lesson who was willing to do some hard thinking and was sufficiently equipped by education and talent to have any rights in the premises. He was not the textbook type of teacher. What he gave in the classroom was more often than not what he currently had under investigation or had just completed. Unfortunately for the rest of us he never wrote a textbook.

His retiring nature, devotion to his work, hatred of publicity, inability to suffer fools with more than extremely moderated gladness, and the caustic vigor of some of his writing combined to give K. P. the reputation among those who did not know him well of being a very austere and difficult sort of person. Actually among his friends, in the laboratory tea room, or at home in Hampstead, he could be a most

genial, kindly, considerate, and entertaining companion. And as is the normal way of life he mellowed as he aged. In purely scientific relations he was unquestionably somewhat difficult. At the core of his being he was an extreme individualist who could not possibly have worked effectively on a "committee"; for anything that touched science however remotely he had his own extraordinarily high standards; and finally his quasi religious zeal for science had in it an element of that sort of intolerance that is so characteristic of all religious behaviour—the sort that tends instantly and automatically to define the two sides of any question as "my side and the wrong one." All these things made discipleship difficult at times. But this does not quite tell the whole story, at least in my own personal experience, for whatever it may be worth. For while K. P. and I fell apart many years ago about some scientific matters, which never thereafter were discussed between us, our friendship grew ever closer and deeper as the years went on, and I am sure mutually so.

So the record stands. A great figure has passed, whose like we shall not see again. The loss to science of a brilliant pioneer is real even though inevitable; to his old students the loss of a friend and worshipped hero is irreparable. For them is left only the comfort inherent in the serene words of Propertius:

At non ingenio quaesitum nomen ab aevo  
Excidet: ingenio stat sine morte decus.

# STATISTICS ON COPPER IN THE UNITED STATES<sup>1</sup>

By Y. S. LEONG  
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IN ITS REPORT to the National Resources Board the Planning Committee for Mineral Policy recommended that consumption forecasts for the nonferrous metals be established "to serve as a guide for current production and for investment in plant facilities."<sup>2</sup> If forecasting is to be attempted, statistical data are indispensable, although it may be questioned whether forecasting for such industries as the nonferrous metals is feasible at all. Statistics are needed not only for forecasting but for measuring and interpreting the changes in the economic activity of these industries. In this paper it is our object to analyze the quality of the existing data on one of the nonferrous metals—copper—with the view of determining their reliability for forecasting copper consumption and in recording the economic changes of the copper industry; to suggest such improvements in the available data as are necessary and such additional compilations as are needed for these purposes.

## PRODUCTION

The United States Bureau of Mines has been compiling for a long period of time annual figures for the mine, smelter and refinery production of copper in the United States from domestic ores. Its mine production statistics are available from 1906 to date, its smelter from 1845 to date, and its refinery from 1906 to date.<sup>3</sup> The mine and refinery figures for the entire period for which the data are available and the smelter figures at least from 1900 on represent practically complete coverage. The three sets of statistics are obtained by canvassing annually all producers engaged in each of the three production processes—mining, smelting, and refining—by means of schedules and through field representatives.

<sup>1</sup> This paper is a summary, with additions and modifications, of a confidential report prepared by Robert W. Burgess and Y. S. Leong for the Central Statistical Board. The author is indebted to Oscar E. Kieseling, Helene M. Myer and Francis J. McCarthy, Jr., of the Bureau of Mines, and Arnyess Joy, of the Central Statistical Board, for assistance and suggestions.

<sup>2</sup> See "Report of the Planning Committee for Mineral Policy," *Report of the National Resources Board*, December 1934, pp. 398–99.

<sup>3</sup> Prior to 1924, these and other figures on copper attributed here to the Bureau of Mines were gathered by the United States Geological Survey, the predecessor of the Bureau of Mines, which has continued the compilations from 1924 to the present. For convenience, these statistics are designated here as those of the Bureau of Mines. Unless otherwise stated all figures compiled by the Bureau of Mines are published in the following sources: prior to 1932, *Mineral Resources of the United States*; 1932 to date, *Minerals Yearbook*, U. S. Bureau of Mines.

The figures for smelter and refinery production seem better adapted to serve as a basis for current analysis than those for mine production. In the first place, there would be a margin of error in mine reports due to the necessity of estimating the recoverable metal content of the ores, although accurate adjustments in recent years have been made possible by the long experience and careful treatment of the Bureau of Mines. In the second place, as there are fewer smelters and refineries than there are mines, it is easier to obtain complete figures currently as needed by canvassing a relatively small number of smelters and refineries. Finally, smelter production represents the copper closer to the consumer.

There is little to choose so far as accuracy is concerned between the figures for smelter production and those for refinery output. Some copper—the Lake Superior variety—is smelted and sold as Lake copper without subsequent refining and some copper is extracted from ores by leaching methods which render smelting unnecessary. The Bureau of Mines in compiling its smelter and refinery figures has adjusted both series for the copper derived from the two sources. Thus its smelter production figures include blister as well as furnace-refined Lake and leached copper, and its refinery output figures include electrolytic as well as furnace-refined Lake and leached copper.

There is a considerable lag in time between the mining and smelting and refining of the copper. Two or three months usually elapse between the mining of the ore and the refining of the copper. For statistical analysis, particularly for forecasting purposes, it would seem that refinery production figures are more useful for they, together with statistics for existing stocks, show precisely the amount of copper available for consumption in a given period of time.

The decennial Census of Mines and Quarries for 1929 collected figures for mine production of copper from practically all producers. As these data have not been published or tabulated, it is not possible to compare the compilations of the Bureau of Mines with the figures gathered by the Census.

Beginning in 1929, the biennial Census of Manufactures has been requesting smelters for figures on blister production and refineries for figures on primary and secondary refinery production of copper. These statistics have also not been published. Even were they available they would not be comparable with those of the Bureau of Mines. In compiling its smelter or blister production figures the Bureau of Mines endeavors to classify the output derived from domestic ores separately from that obtained from foreign ores. The Census schedule calls for blister copper without reference to source. The Bureau of Mines segre-

gates its primary refinery output figures into domestic and foreign, while the Census calls for primary refinery data regardless of source. Finally the Bureau of Mines adjusts its smelter and refinery production figures for furnace-refined Lake copper and copper produced directly through the leaching of ores. In the Census schedule no mention is made of the copper derived from these processes.

As the Census of Mines and Quarries and the Census of Manufactures have never tabulated the production data they gathered, nor have they made use of them in any way except for checking purposes, and as the figures for blister and refinery production do not conform to the fundamental classifications of the Bureau of Mines, it is suggested that the Bureau of the Census and the Bureau of Mines should cooperate to formulate a joint schedule which will incorporate all the information essential to the two agencies. Such a cooperative effort will eliminate much of the existing duplication.

Monthly figures for mine production are available from January 1921 to December 1931 and for smelter production from January 1923 to December 1931. These series were compiled by the American Bureau of Metal Statistics which discontinued their reporting at the end of 1931.<sup>4</sup> Comparison of the annual totals of the monthly figures for mine production compiled by the American Bureau with the annual figures for mine production of the Bureau of Mines indicates that the two series are closely similar. The annual totals of the monthly figures for blister production of the American Bureau are, however, consistently higher than the annual figures for smelter production of the Bureau of Mines. The higher figures of the American Bureau are explained by the fact that they include some foreign and secondary copper. Taking into consideration the fact that they had to be reported currently, the figures for mine and smelter production of the American Bureau may be said to be sufficiently close to the truth to serve the purpose of current market analysis. It is regrettable that their reporting was terminated.

Since June 1933 the Copper Institute, the statistical subsidiary of the former Code Authority for the Copper Industry, has been compiling monthly figures for mine or smelter production of copper derived from domestic and duty-free ores,<sup>5</sup> and from secondary materials. These figures include the estimated recoverable copper contents of concentrates, blister and Lake copper produced, and are segregated

<sup>4</sup> These and other monthly series compiled by the American Bureau of Metal Statistics were reported regularly through mimeographed releases issued monthly. These statistics were also published in the *Survey of Current Business*, U. S. Bureau of Foreign and Domestic Commerce.

<sup>5</sup> Some 6,000 tons of duty-free copper are imported from Cuba each year.

into three series: primary copper produced by members of the Industry, primary custom production and secondary custom production. The series for primary copper produced by members of the Industry represents mainly mine production data. This, together with that for primary custom production, covers the mine output of practically the entire Copper Industry.

It is regrettable that the Copper Institute has not made public these figures nor any of its other valuable statistics,<sup>6</sup> which we shall have occasion to discuss later. Its compilations are intended for the confidential use of the members of the Industry. Recently, however, some of its figures on production, consumption and stocks have appeared regularly in trade journals,<sup>7</sup> apparently without the official sanction of the Institute. There is, of course, no assurance that their publication would continue indefinitely—would not cease, for instance, in the event that the statistical position of the Industry should be less favorable than it is now. The Institute cannot be too strongly urged to make its figures available to the public at all times, at least to make them available unconditionally for the use of such a government agency as the Bureau of Mines. If it should withhold from the public those monthly statistics which are needed for current analysis, it is suggested that the Bureau of Mines as an impartial agency undertake to compile them.

For statistical analysis, it is desirable to have a comparable and continuous monthly series going as far back as possible. The Institute's figures for mine or smelter production date back only to June 1933. For many years prior to June 1933, the Institute had been compiling monthly data on mine or smelter production. These figures have not been published and it is not known to what extent they differ from those compiled since the middle of 1933. It should be possible, however, on the basis of these earlier data and the annual figures of the Bureau of Mines to splice the Institute's present figures on the American Bureau's mine production series which, it will be recalled, began in January 1921 and discontinued in December 1931. Thus we shall have a continuous monthly series dating at least as far back as the beginning of 1921.

The Institute has also estimated the amount of refined copper<sup>8</sup> pro-

<sup>6</sup> The Copper Institute issues confidential, monthly mimeographed releases to the members of the Copper Industry, showing monthly figures of production, stocks, consumption, sales, and unfilled sales in the United States and also in the world and giving a list of the reporting companies.

<sup>7</sup> These figures are published regularly, usually soon after the 15th of the following month, in the *American Metal Market*, the *Wall Street Journal*, and other periodicals.

<sup>8</sup> In this connection it should be mentioned that a monthly series, dating back to January 1919, is available for refinery production of copper in North and South America. The figures from 1919 to 1923 were compiled by the Copper Export Association and since then by the American Bureau of Metal Statistics. Prior to December 1931, the American Bureau reported its data monthly but since then it

duced monthly by adding the change in producers' stocks to domestic invoicings and exports of domestic and duty-free copper. The figures so derived include some secondary copper, that is, copper produced from scrap by refineries engaged principally in the production of primary copper. The Institute should be able to compile a more accurate monthly series for refinery production by canvassing the refineries directly. Inasmuch as the number of refineries is relatively small, the canvassing should not be difficult. In compiling the refinery data, it is suggested that primary and secondary production be classified separately and primary output be segregated into that which is produced from domestic ores and that which is derived from foreign sources.

Any analysis of the activity in the Copper Industry would be incomplete without taking into consideration the output of secondary copper, that is, copper derived from new and old copper and brass scrap. The production of secondary copper has become more and more an important factor in the copper market and will become an even more significant factor in the future. In recent years it exceeded primary output by as much as a third. Moreover, its importance as a market factor is augmented by the fact that it is more elastic than primary output, that is, an increase in price is likely to call forth a greater volume of secondary than of primary production. The only available statistics representing practically complete coverage of the secondary output are those compiled once a year since 1906 by the Bureau of Mines. If current statistical investigations, such as forecasting, are to be made, figures for secondary copper production at quarterly, if not monthly, intervals should be compiled and published regularly.

#### EMPLOYMENT AND PAYROLLS

Two related types of data should perhaps be mentioned in connection with the production figures: employment and payrolls. While statistics on employment and payrolls are not pertinent to the problem of forecasting the consumption of copper, they are, nevertheless, valuable for the purpose of studying the economic behavior of the Copper Industry.

The Bureau of Mines in making its annual surveys of mine accidents has, since 1911, been compiling annual figures showing the average number of persons employed in copper mining during that period of

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has been publishing its monthly figures only once a year in the *Year Book of the American Bureau of Metal Statistics*. For analyses of domestic market trends this series, because of its inclusion of copper produced in foreign countries, is of little value.



each year in which the mines are in operation.<sup>9</sup> It has never gathered, however, any data on payrolls. Figures on a quinquennial basis for the number of wage earners reported as employed in the mining of copper on the 15th day of each month and the total payments to workers in copper mining during the year have been assembled by the Census of Mines and Quarries.<sup>10</sup> The Census of Manufactures has been compiling biennial figures showing the number of wage earners on the payrolls of establishments engaged in the smelting and refining of copper for the week which included the 15th day of each month and the total amount of wages paid to the workers in these establishments during the year.<sup>11</sup>

Monthly statistics for the number of wage earners engaged in the mining, smelting or refining of copper and for the amount of wages paid to these workers are not separately available. The Bureau of Labor Statistics, however, has, since January 1931, been gathering monthly figures for the number of wage earners and the amount of wages paid to these workers in the week ending nearest the 15th of the month in the metal-mining industries, which are published under the caption "metalliferous mining," and which include the copper mining industry. But the figures for the copper mining industry alone have never been published. Similarly the monthly figures compiled by the Bureau for employment and payrolls in the smelting and refining divisions of the Copper Industry are not separately shown but classified under "smelting and refining—copper, lead and zinc."<sup>12</sup>

As complementary measures of productive activity employment and payroll data for the metal industries are sufficiently important to merit a more refined classification than that which is adopted by the Bureau of Labor Statistics. It is hoped that the Bureau will soon have monthly figures showing employment and payrolls for each of the three production divisions of the Copper Industry—mining, smelting, and refining.

#### STOCKS

Since 1906 the Bureau of Mines has been compiling once a year two series, one showing the stocks of "blister and materials in process of refining" and the other, the stocks of "refined copper" located in smelters and refineries in the United States, as of the first of each year.

<sup>9</sup> Employment data gathered by the Bureau of Mines are published in *Metal-Mine Accidents in the United States*.

<sup>10</sup> *Mines and Quarries—1929*, 15th Census of the United States, U. S. Bureau of the Census.

<sup>11</sup> For figures on employment and wages, 1899-1929, see *Manufacturing—1929*, 15th Census of the United States; for those subsequent to 1929 see *Biennial Census of Manufacturers*, U. S. Bureau of the Census.

<sup>12</sup> See *Employment and Payrolls*, a monthly publication of the U. S. Bureau of Labor Statistics.

Practically every smelter and refinery has been covered in the canvass. These figures are defective in that they fail to show the large stocks of copper held by the fabricators of copper products and the consumers of copper. In recent years these consumers and manufacturers have been holding a considerable amount of copper.

Since June 1933 the Copper Institute has been compiling monthly figures showing the stocks of copper held in the Industry and outside of the Industry at the end of each month.<sup>13</sup> Industry or producers' stocks are classified into those held at refineries and those on consignments. The Institute also estimates the surplus stocks of copper controlled by the copper producers by deducting from the total producers' stocks the amount of copper sold but not delivered, and the estimated normal stocks necessary for the producers to carry. The coverage of the producers' stock figures is practically complete. Non-industry stocks are segregated into those held by consumers, by non-consumers and at the New York Commodity Exchange. Consumers' stocks are subdivided into "consumers' stocks at refineries," "refinery shapes at consumers' plants," and "copper in process of fabrication and in fabricated forms at consumers' plants and warehouses." By adding the "unfilled purchases of refined copper under contracts" to, and deducting the "unfilled sales of copper products under contracts" and the estimated "normal stocks required for half a month's consumption" from the total consumers' stocks, the Institute arrives at an estimate of the surplus stocks controlled by the copper consumers. Consumers' stocks data cover the copper carried by the important copper users, who hold practically all the available refined stocks except those in the hands of the producers and speculators. Non-consumers' or speculators' stock figures indicate the copper held by purchasers other than those having fabricating plants or having fabrication done for them on toll. The stocks held by speculators comprise but a small fraction of the total stocks. Probably most of the small amount of copper stocks at the New York Commodity Exchange is to be attributed to the speculators.

The Copper Industry has in recent years been cursed with excessive stocks carried by producers and consumers. The stock data should

<sup>13</sup> Monthly figures for refined copper stocks located in refineries in North and South America at the end of each month are available from January 1919 to date. From 1919 to 1923 they were compiled by the Copper Export Association and from 1923 to the present by the American Bureau of Metal Statistics. Prior to December 1931, the American Bureau reported these data monthly but since then it has been publishing them only once a year in the *Year Book of the American Bureau of Metal Statistics*. These statistics represent largely producers' stocks. Comparison of the annual totals of the monthly figures for refined stocks in North and South America with the annual figures for refined stocks in the United States, as compiled by the Bureau of Mines, indicates that there is on the whole a close agreement between the two series. A convenient source of these data is the *Survey of Current Business*. (See 1932 Annual Supplement and 1936 Supplement.)

continue to aid the copper producers in their efforts to stabilize their output and both the producers and users of the metal in their efforts to reduce their stocks or to prevent unduly large accumulation of their stocks. The stock figures of the Institute should be exceedingly helpful to those analyzing the supply and demand situation in copper and to business men who have to decide policies in this field of industrial activity. In recent months two of the Institute's stock series have been published in trade journals, one for refined stocks held by producers and the other for total refined stocks.

#### SALES AND SHIPMENTS

Since June 1933 the Copper Institute has been estimating monthly sales of copper in tons, made domestically by members of the Copper Industry.<sup>14</sup> These figures are arrived at by adding the domestic invoicings to the change in the total unfilled sales contracts of the copper producers. The Institute has also been computing monthly figures showing consumers' physical volume sales of products fabricated from copper originating in the Copper Industry. These sales data, like the other figures which the Institute compiles, are kept confidential.

If reliable data on production and stocks are available, the gathering of statistics on sales or shipments is not indispensable, for it is possible on the basis of the information on production and stocks to derive figures on sales and shipments.

#### EXPORTS AND IMPORTS

Monthly figures of the exports and imports of copper in quantity and value are available from 1866 to the present.<sup>15</sup> The number of classifications in the earlier years was comparatively small. The figures were regrouped from time to time, with some of the old classifications discarded and new ones added. At the present time figures for copper exports as compiled by the Bureau of Foreign and Domestic Commerce are grouped into nine major classes: (1) ores, concentrates, matte, blister, etc.; (2) refined copper in ingots, bars, etc.; (3) old and scrap; (4) pipes and tubes; (5) plates and sheets; (6) rods; (7) wires; (8) insulated copper wire and cable; (9) other copper manufactures. Copper imports which are designated as "imports for consumption" are classi-

<sup>14</sup> Monthly figures showing the shipments of refined copper to the United States from refineries located in North and South America are available from January 1919 to date. The figures prior to January 1924 were gathered by the Copper Export Association; those from January 1924 to the present have been compiled by the American Bureau of Metal Statistics. Until December 1931 the American Bureau reported these data monthly; since then, it has been publishing them only once a year in the *Year Book of the American Bureau of Metal Statistics*.

<sup>15</sup> Monthly figures for exports and imports are published in *Monthly Summary of Foreign Commerce of the United States*, U. S. Bureau of Foreign and Domestic Commerce.

fied in to eight groups: (1) bonded for smelting, refining and export; (2) Cuban concentrates; (3) regulus, coarse metal, etc.; (4) unrefined, black, blister, etc.; (5) refined; (6) scrap; (7) composition metal; (8) copper manufactures not otherwise specified.

Except for the small amount which is withdrawn for domestic consumption, the copper imported in bond will eventually be exported. It should be pointed out, however, that the figures for copper imports "bonded for smelting, refining and export" as reported by the Bureau of Foreign and Domestic Commerce do not represent the copper actually imported during any given month but that exported during the month.<sup>16</sup> In other words, copper imports in bond are not reported in the publication of the Bureau of Foreign and Domestic Commerce until the month in which they are exported. This being true, it follows that the difference between its exports of a given month and the "imports for consumption" of that same month will approximate closely the net exports (or the net imports, as the case may be) of that month.

#### PRICES

The Bureau of Mines has been compiling an annual price series showing the weighted prices of copper in the United States from 1850 to the present. These figures represent prices obtained by copper-selling agencies in the United States weighted by the quantities sold.

The *Engineering and Mining Journal* and the *American Metal Market*, among others, have been compiling average monthly prices for electrolytic copper in New York. Both sources are widely used. Because of a difference in the basis used the quotations of the *Engineering and Mining Journal* are invariably lower than the *American Metal Market* prices at New York.<sup>17</sup> The *American Metal Market* quotations at New York, in turn, are 0.125 of a cent per pound lower than prices delivered at Connecticut points. The copper prices used by the United States Bureau of Labor Statistics in its Index of Wholesale Prices are identical with the *American Metal Market* quotations at New York.

Attention should perhaps be called to another price quotation—the price for electrolytic copper delivered free alongside ship (F.A.S.) for export, which is quoted by the *American Metal Market* and other

<sup>16</sup> The copper imported for smelting, refining, and export is designated as "entries for warehouse" upon its entrance into the United States. "Entries for warehouse" for any given month, therefore, represent the copper actually imported during that month. When the copper is finally exported, it is shown in the publications of the Bureau of Foreign and Domestic Commerce as "copper imports bonded for smelting, refining and export" for the month in which the metal is exported. Since January 1934, however, figures showing "entries for warehouse" have not been published.

<sup>17</sup> The *Engineering and Mining Journal* series is based on sales for both prompt and future deliveries and, therefore, represent average of weighted prices for the month. The *American Metal Market* series, on the other hand, represent the average of unweighted daily prices for the month.

journals. When the domestic price of copper is fixed by agreement among producers, as for instance when the Code of Fair Competition for the Copper Industry was in effect, this quotation reflects the influence of supply and demand factors and represents the best domestic version of the world price of copper.

#### CONSUMPTION

Actual statistics of the amount of copper consumed in the United States are not available. The Bureau of Mines has estimated the amount of new copper withdrawn annually from available supply on domestic account by adding its stocks at the beginning of the year to, and deducting the copper exported during the year and the stocks at the end of the year from, the total supply of new copper of the given year. The new copper withdrawn in any given year, however, does not show the actual consumption of the year, for in the first place, the consumers' stocks are not taken into account, in the second place, some of the copper withdrawn may later be exported in the form of fabricated products, and finally, there is a considerable amount of secondary copper consumed which is not included in the figures of new copper withdrawals.

Since June 1933 the Copper Institute has been estimating the monthly consumption of domestic and duty-free copper in the United States. These estimates are made on the basis of domestic invoicings by the copper industry and changes in the stocks of consumers and speculators, with some allowance for domestic and duty-free copper exported in unfabricated forms. They are an improvement over those of the Bureau of Mines, for they take into account the changes in the stocks of consumers and speculators and include that part of the output of secondary which is produced in the plants of the Copper Industry. They are defective, nevertheless, in at least two respects: in the first place, some of the copper which is in the process of fabrication at the date of one monthly report may later be exported in manufactured form, and in the second place, no account is taken of the consumption of that large part of the secondary output which is produced by secondary producers who are outside of the copper industry.

Even if the consumption estimates of the Bureau of Mines and the Copper Institute were free from defects, their use for forecasting purposes would nevertheless be limited. For short-time forecasting, or for any current economic analysis these over-all figures would not reveal the differences in the changes of the business activities of the various copper-consuming industries during the various phases of the business cycle. The automobile industry, for instance, has during the recent

recovery phase increased its business activities considerably more than some of the other copper-consuming industries, such as the electrical and building industries. In any over-all figures, however, this rise in the use of copper in one industry may be obscured by a decline in other industries. Even for the study of long-time trend, these estimates of consumption tend to obfuscate the differences in the rates of growth of some industries and the dissimilarities in the rates of decline in others. Some of the copper-consuming industries may, or will soon, have attained their maximum growth, and their trends are likely to flatten out, if not to decline, in the near future. Others may continue to grow for some years to come. If reliable forecasts of copper consumption are to be undertaken currently, statistics on copper consumption by industries, compiled regularly at quarterly or monthly intervals, are absolutely essential.

The only available figures showing the amount of copper consumed by copper-using industries are those of the American Bureau of Metal Statistics.<sup>18</sup> These are estimated figures, representing the quantity of copper used annually by the following industries or groups of industries: electrical manufacture, telephone and telegraph, light and power, wire cloth, other rod and wire, ammunition, automobile, building, casting, clock and watch, coinage, copper-bearing steel, fire-fighting apparatus, radiator and heating, radio, railway equipment, refrigerator, shipbuilding, washing machine, water heater, air conditioning, manufactures for export, and others. The American Bureau has not made public the methods by which each of its series was estimated.<sup>19</sup> In the absence of information as to how these figures were actually obtained, there is, of course, no satisfactory way of testing their accuracy.

Some idea of the reliability of these estimates may be obtained by comparing them to some series which reflect the productive or business activities of the corresponding copper-using industries. It should be pointed out, however, that perfect correlation between the estimated series representing copper consumption and the series indicative of business changes in that copper-consuming industry does not neces-

<sup>18</sup> See *Year Books of the American Bureau of Metal Statistics*.

<sup>19</sup> Upon inquiry, the American Bureau disclosed that in general its methods are "adapted to what is industrially practicable." In some cases, a complete or practically complete canvass of all manufactures is made. In others, where the reports are incomplete but where they are "representative of so large a proportion (commonly upward of 50 per cent)," the estimates are made on the assumption that the total use of copper in the copper-using industry is in the same ratio as the sample. In still others the estimates are arrived at by applying the average amount of copper consumed per unit of production to the total number of articles reported to have been manufactured by the copper-using industry. Efforts made to obtain more specific information from the American Bureau than that which is outlined above have not been successful.

sarily mean that the estimated figures are reliable. It may well be that the very series which we use for comparison were actually employed by the American Bureau as a basis for its estimates.

Graphic comparisons of the more important of the estimated series with such data reflecting the business activities in the corresponding copper-using industries as are available shows that, on the whole, there is a general agreement between the changes in the amount of copper consumed in the several industries or industrial groups and the fluctuations in those series indicative of the business operations of the corresponding copper-consuming industries. Nevertheless, a definite conclusion cannot be drawn regarding the accuracy of the estimates unless the method by which they were arrived at is known. Only if it can be established that they were obtained by canvassing the users of copper and not on the basis of those series which reflect the business changes of the copper-consuming industries may the estimates be said to be fairly reliable.

#### CONCLUSION

Copper is an important national resource which is exhaustible and irreplaceable. It should be conserved by wise and efficient use. Complete quarterly or monthly statistics covering all factors of supply and demand—primary and secondary production, producers' and consumers' stocks, exports and imports, prices, and consumption by principal copper-using industries—should be compiled to aid in the development of a conservation program, if for no other purpose. Where such data are not available it is suggested that the Bureau of Mines, which has had long experience in gathering mineral statistics, undertake to fill in the gap. These compilations should be published promptly and regularly and should be presented in the form of totals so as not to reveal information concerning the individual companies.

## THE PROBABILITY DISTRIBUTION OF PROTECTION TEST RESULTS

BY HUGO MUENCH  
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THE PROTECTION test is based on the ability of the serum of individuals who have recovered from certain infections to protect susceptible test animals from the results of inoculation with the infective agent. Preferably, the result is readable on the basis of the numbers of animals surviving and dying in a group used to test a given serum. High mortality in the group is taken to indicate lack of protective power in the serum. Conversely, low mortality is interpreted as meaning that the serum contains protective substances and hence was furnished by an individual who has most probably, in the past, recovered from an attack by the same infective agent. Animals used in such protection tests may therefore be divided into two hypothetical populations: the "protected" which have received positive serum and the "unprotected" receiving negative serum.

A group of  $n$  animals used to test a serum corresponds to an  $n$ th power binomial in that  $(n+1)$  different results are possible. In order to establish criteria for the classification of sera into "positive" and "negative" categories, it is necessary to know something of the frequency distribution of these possible results in the case of either class. Once we know the relative frequency of occurrence of a given test result in either case, we can state with some certainty the probability that a serum giving this result is positive.

The analyses in this paper are based on the yellow fever protection test, for which a great amount of material is available. The technique of this test has been described [1, 2].<sup>1</sup> The infective agent is neurotropic yellow fever virus. Under the conditions of the test this is lethal to the animals used, which are white mice of a quite uniformly susceptible strain. Considerable protection against death is afforded the mice by sera of individuals who have recovered from yellow fever even many years previously. The results are read as a fraction (as 5/6) of which the denominator is the number of mice alive four days after inoculation, the numerator the number surviving six days later or ten days after inoculation. Groups of six mice are standard, though results can be read also on the basis of four or five. This study is confined to

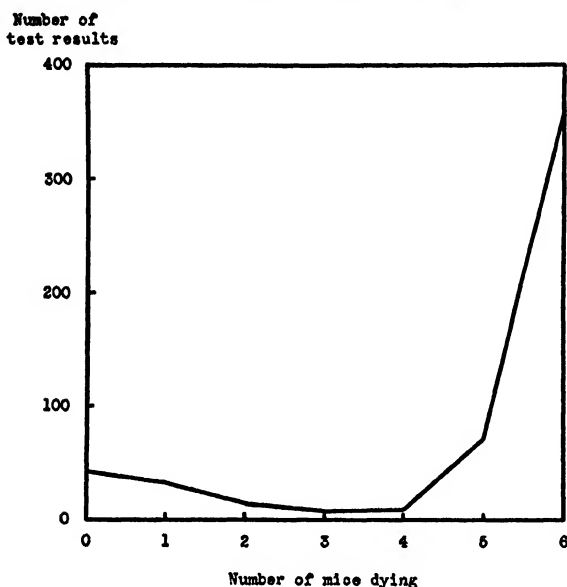
<sup>1</sup> The numbers in brackets refer to the bibliography on p. 689.



the analysis of six-mouse results, and these results are expressed in this paper in terms of mice dying rather than those surviving, as we are concerned specifically with mortality rates.

When the results of a "run" of a considerable number of tests are plotted (Figure 1) it is generally found that the array is bimodal. One peak is at or near 0/6 deaths and the other at the other end of the range, or 6/6. This would indicate that the array of test results was a mixture of samples from two different populations, possibly corresponding to those "protected" and "unprotected" which have been postulated.

FIGURE 1  
RESULTS OF TYPICAL "RUN" OF TESTS



The question now is: What are the characteristics of the two parent populations? The essential difference between the two would naturally lie in the lowering of the mortality rate resulting from the injection of immune serum into the mice. A protection test technique, employing fixed quantities of a stable virus, would be expected to show a relatively fixed mortality rate in a uniform mouse population receiving serum with no protective power. Those mice receiving a protective serum should show a mortality rate below the first to an extent depending on the degree of protective power of the serum. As a matter of fact, a practical problem in the development of any protection test is the gauging of virus and serum dosages so that there shall be the widest possible difference between the two mortality rates.

The question then becomes: What is the value, or the distribution, of the mortality rate for each of the parent populations? If the rate is expressible in a single value, as  $p$ , then each population is represented in the array of test results by a simple binomial of the form  $[p + (1 - p)]^n$ , where  $n$  is the number of mice used in each test group. If the rate is not a single value but rather a distribution, then the result will be of a more complex binomial type. To begin with, we may assume that single values can express both "protected" and "unprotected" mortalities, respectively; the solution then is the separation of the simple binomials of which the array of test results is assumed to be composed. There are several ways to go about this:

Suppose we assume that "protected" mortality is so low that it will scarcely affect the number of results with five and six deaths. Then we can find a value for the "unprotected" mortality rate from these two points by

$$(1a) \quad p = ny_n / (ny_n + y_{n-1}) .$$

Conversely, assuming that "unprotected" mortality is so high that the number of tests showing one or no deaths will not be seriously affected, we can determine a value for "protected" mortality by

$$(1b) \quad \pi = y_1 / (ny_0 + y_1)$$

where  $p$  = mortality rate in "unprotected" mice

$\pi$  = that among "protected" mice

$n$  = the power of the binomial (in this case 6)

$y_i$  = the number of tests showing  $i$  deaths.

From each of these two values, the remainder of the hypothetical distribution of the corresponding fraction is calculated by simply extending the binomial through the remaining terms.

This method, which we may call the "endpoint fit," is illustrated by an example (Table I) employing the data plotted in Figure 1. This was an actual run of 528 sera from Brazil and Venezuela. The mortality rates were obtained by equations (1) as follows:

$$\begin{aligned} p &= (355 \times 6) / (355 \times 6 + 71) = 0.9677 \\ \pi &= 31 / (42 \times 6 + 31) = 0.1095 \end{aligned}$$

Evidently the sum of the two binomials does not account for the frequencies in the intermediate terms of the array. The discrepancy is serious, as " $P$ " (by chi-square) is only 0.00095. A similar discrepancy appears regularly whenever positive sera are included in a run; it is never in the opposite direction. When a run consisted of negative sera only, the "endpoint" fit has always been good.

By the "endpoint" method, each derived mortality rate depends on only two frequencies. It must therefore suffer considerably from sampling fluctuations. To overcome this difficulty, it is possible to derive values for both rates simultaneously, from all elements of the array, by a method of moments.<sup>2</sup> In a "double binomial," such as is assumed here, three unknowns must be found:

$P$  = "unprotected" mortality

$\pi$  = "protected" mortality

$U$  = proportion of all tests "unprotective" (i.e., negative)

Further, we shall use

$x$  = result in number of deaths per mouse group

$y_x$  = number of tests giving such result

$n$  = power of binomial (number of mice per group) and

$\nu_\alpha$  = the  $\alpha$ th moment of the array ( $= \Sigma x^\alpha y / \Sigma y$ )

The moments of the double binomial are

$$\begin{aligned} \nu_1 &= n[Up + (1 - U)\pi] \\ \nu_2 &= n[Up + (1 - U)\pi] + n(n - 1)[Up^2 + (1 - U)\pi^2] \\ (2) \quad \nu_3 &= n[Up + (1 - U)\pi] + 3n(n - 1)[Up^2 + (1 - U)\pi^2] \\ &\quad + n(n - 1)(n - 2)[Up^3 + (1 - U)\pi^3] \end{aligned}$$

and from them the following functions are derived:

$$\begin{aligned} \phi_1 &= \nu_1/n = Up + (1 - U)\pi \\ (3) \quad \phi_2 &= (\nu_2 - \nu_1)/(n(n - 1)) = Up^2 + (1 - U)\pi^2 \\ \phi_3 &= (\nu_3 - 3\nu_2 + 2\nu_1)/(n(n - 1)(n - 2)) = Up^3 + (1 - U)\pi^3. \end{aligned}$$

On solving, it is found that  $\pi$  is one root of the equation

$$(4) \quad \pi^2(\phi_1^2 - \phi_2) + \pi(\phi_3 - \phi_1\phi_2) + (\phi_2^2 - \phi_1\phi_3) = 0$$

while  $p$  is the other root.  $p$  is given also by

$$(5) \quad p = (\phi_2 - \phi_1\pi)/(\phi_1 - \pi)$$

and  $U$  by

$$(6) \quad U = (\phi_1 - \pi)/(p - \pi).$$

Using this method on the data of Table I, the results are:

$\Sigma xy$	2,599	$\nu_1$	4.92235	$\phi_1$	0.82039
$\Sigma x^2 y$	14,845	$\nu_2$	28.11552	$\phi_2$	0.77311
$\Sigma x^3 y$	86,455	$\nu_3$	163.74050	$\phi_3$	0.74366
$-0.10007\pi^2 + 0.10941\pi - 0.01239 = 0$					

<sup>2</sup> Pearson [3] published a solution for the "double binomial" when the power of the binomial was unknown. When it is fixed, the solution is greatly simplified.

$$\pi = 0.5467 - 0.4184 = 0.1283$$

$$p = 0.5467 + 0.4184 = 0.9651$$

$$U = 0.6921/0.8368 = 0.8271$$

TABLE I  
"ENDPOINT" FIT

Test Results								
	Number of Mice Dying							Total
	0	1	2	3	4	5	6	
Observed frequencies	42	31	13	7	9	71	355	528
Hypothetical $\{p = 0.9677$	—	—	—	0.3	6.0	71.0	355.0	432.3
frequencies for $\{\pi = 0.1095$	42.0	31.0	9.5	1.6	0.1	—	—	84.2
Hypothetical totals	42.0	31.0	9.5	1.9	6.1	71.0	355.0	516.5

The fitted frequencies for these mortalities are shown in Table II. The fit is now much better ( $P = 0.06$ ) and it is evident that the deviations of hypothetical frequencies from observed are more evenly distributed. But there is still a tendency to "undershooting" in the mid-zone, balanced by compensating deviations at the ends, and this again is the picture whenever we fit runs of tests containing a number of positive sera.

TABLE II  
"DOUBLE BINOMIAL" FIT

Test Results								
	Number of Mice Dying							Total
	0	1	2	3	4	5	6	
Observed frequencies	42	31	13	7	9	71	355	528
Hypothetical $\{p = 0.9651$	—	—	—	0.3	6.9	76.6	352.9	436.7
frequencies for $\{\pi = 0.1283$	40.0	35.4	13.0	2.6	0.3	—	—	91.3
Hypothetical totals	40.0	35.4	13.0	2.9	7.2	76.6	352.9	528.0

The assumption of single mortality values clearly does not hold. The difficulty is probably with positive or "protective" sera, for the following reasons:<sup>3</sup>

- Runs including negatives only are well fitted by simple binominals.
- The values of " $p$ " derived from endpoint fits are usually close to those given by the double binomial method. " $\pi$ " is generally higher by the latter method.

<sup>3</sup> See also references [4].

- (c) Successive runs from the same laboratory give values for " $p$ " differing very little and lying on a trend that rises slightly with time. Successive values of " $\pi$ " vary widely, indicating sampling from a broader universe.

If the mortalities are not single values, they must occupy a band within which they are distributed in some fashion. The limits of this band must be between 0 and 1; further than this we cannot specify. The nature of the distribution within the band may be highly arbitrary, since it depends on the particular group of sera being tested. For example, a run which happened to include a large number of sera of high protective value would have a distribution of "protected" mortalities different from that of a run in which most of the positive sera were weakly protective. We cannot therefore rationalize the choice of any particular function to describe the distribution of mortalities on theoretical grounds and so shall confine ourselves to the following assumptions:

- (a) Mortality values may fall anywhere between 0 and 1, and may therefore be expressed by some continuous function with these limits.
- (b) In large arrays of tests, inequalities between different groups of sera will disappear sufficiently to allow the mortality distributions of the totals to approach a regular form.
- (c) These distributions may be described with sufficient accuracy by some simple form of probability curve that the constants of the curve (such as mean and standard deviation) will have a real meaning. We may call this the "curve of origin."

The curve of origin will give rise to a complex or "chain" binomial whose form is determined by the shape of the curve. Then, if we are able to fit such a chain binomial to an actual series of test results, we may conclude that its curve of origin does present something very much like a picture of the variations of the underlying mortality rate. Since the choice of a function for the curve must be largely empirical, we may select one which is reasonably flexible in its possible shapes and which may readily be integrated with the binomial.

Greenwood and Yule [5] studied "chain Poisson" series arising from curves of the type

$$y = kx^n e^{-ax}$$

This distribution is not appropriate here, since both the series and the curve of origin extend to infinity while we are limited to a binomial and to mortalities ranging from 0 to 1. Nevertheless, reasonably good

approximations to our data can be obtained by this method since in this case the "tails" are so small that they are relatively unimportant.

For our purposes, as curve of origin, it is better to try the function

$$(7) \quad y = kp^s(1-p)^t$$

where<sup>4</sup>  $k = (s+t+1)!/(s!t!)$  when the area under the curve is put equal to 1. The curve may take almost any simple shape between the limits of 0 and 1, which are those of the possible mortality range.

The development of the chain binomial arising from this curve can be handled by methods analogous to those used by Greenwood and Yule (*loc. cit.*) for the chain Poisson. The notation is simple:

$p$  (or  $\pi$ ) = mortality rate

$n$  = power of binomial (number of mice in group)

$s$  and  $t$  = parameters of the curve of origin (equation [7])

Then for the relative frequency of results with no deaths, we have

$$(8) \quad \begin{aligned} f_0 &= \frac{(s+t+1)!}{s!t!} \int_0^1 p^s(1-p)^t(1-p)^n dp \\ &= \frac{(s+t+1)!}{s!t!} \frac{s!(t+n)!}{(s+t+n+1)!} \end{aligned}$$

and for the frequency of results with one death

$$(9) \quad \begin{aligned} f_1 &= \frac{(s+t+1)!}{s!t!} \int_0^1 p^s(1-p)^t n p(1-p)^{n-1} dp \\ &= n \frac{(s+t+1)!}{s!t!} \frac{(s+1)!(t+n-1)!}{(s+t+n+1)!} \end{aligned}$$

and so to the frequency at  $n$  deaths, which is

$$(10) \quad \begin{aligned} f_n &= \frac{(s+t+1)!}{s!t!} \int_0^1 p^s(1-p)^t p^n dp \\ &\quad \frac{(s+t+1)!}{s!t!} \frac{(s+n)!t!}{(s+t+n+1)!} \end{aligned}$$

Summing, we have for the entire array

$$\Sigma y = \frac{(s+t+1)!}{s!t!} \frac{s!t!}{(s+t+n+1)!} \left[ (t+1)(t+2) \cdots (t+n) \right]$$

<sup>4</sup> Pi-functions or generalised factorials (written " $n!$ ") are here used in place of the more usual Gamma-functions, in order to simplify subsequent procedures.

$$\begin{aligned}
 (11) \quad & + \frac{n}{1!} (s+1)(t+1) \cdots (t+n-1) \\
 & + \frac{n(n-1)}{2!} (s+1)(s+2)(t+1) \cdots (t+n-2) + \cdots \\
 & + \frac{n!}{n!} (s+1) \cdots (s+n) \Big] \\
 & \frac{(s+t+2) \cdots (s+t+n+1)}{(s+t+2) \cdots (s+t+n+1)} = 1
 \end{aligned}$$

The elements of the first equation of (11) give the relative frequencies of the elements of an  $n$ th-power chain binomial array arising from a frequency curve of the type of equation (7) and with parameters of  $s$ ,  $t$ . These parameters may be obtained from the first and second moments of the actual array, since (when  $\Sigma y = 1$ )

$$\begin{aligned}
 \Sigma xy = \nu_1 &= \frac{1}{(s+t+2) \cdots (s+t+n+1)} \\
 & [0 + n(s+1)(t+1) \cdots (t+n-1) \\
 & + n(n-1)(s+1)(s+2)(t+1) \cdots (t+n-2) + \cdots \\
 (12) \quad & + n(s+1) \cdots (s+n)] \\
 & = \frac{n(s+1)}{(s+t+2) \cdots (s+t+n+1)} \\
 & [(s+t+3) \cdots (s+t+n+1)] = \frac{n(s+1)}{s+t+2} \\
 \Sigma x^2 y = \nu_2 &= \frac{1}{(s+t+2) \cdots (s+t+n+1)} \\
 & [0 + n(s+1)(t+1) \cdots (t+n-1) \\
 & + 2n(n-1)(s+1)(s+2)(t+1) \cdots (t+n-2) \\
 & + \frac{3n(n-1)(n-2)}{2!} (s+1) \cdots (s+3)(t+1) \\
 (13) \quad & \cdots (t+n-3) + \cdots + n^2(s+1) \cdots (s+n)] \\
 & \frac{n(s+1)}{(s+t+2) \cdots (s+t+n+1)} \\
 & [(s+t+4) \cdots (s+t+n+1)(ns+t+2n+1)] \\
 & \frac{n(s+1)(ns+t+2n+1)}{(s+t+2)(s+t+3)}
 \end{aligned}$$

where  $x$  is the number of mice dying per group.

$\phi$  functions are calculated as in equation (3). They are:

$$\begin{aligned} \phi_1 &= v_1/n = (s+1)/(s+t+2) \\ (14) \quad \phi_2 &= (v_2 - v_1)/(n(n-1)) \\ &= [(s+1)(s+2)]/[(s+t+2)(s+t+3)] \end{aligned}$$

and from them the parameters  $s, t$  are calculated by

$$(15) \quad s = (\phi_1(\phi_1 - \phi_2))/(\phi_2 - \phi_1^2) - 1$$

$$(16) \quad t = (n+1)/\phi_1 - (n+2).$$

The  $\phi$  functions of the chain binomial are exactly the same as the corresponding moments about zero ( $v_s$ ) of the curve of origin. The characteristics of this curve are:

$$\begin{aligned} \text{Mode} &= s/(s+t) & \text{Mean} &= v_1 = (s+1)/(s+t+2) \\ \mu_2 &= \sigma^2 = [(s+1)(t+1)]/[(s+t+2)^2(s+t+3)]. \end{aligned}$$

Since there is no direct method for the separation of a mixture of two samples distributed on this basis, it is necessary to use a method of successive approximations. This requires a large number of test results. Therefore the tests of an entire year from one laboratory were included in one array. Tests covering two years (1933-4 and 1934-5) for each of two laboratories (New York and Bahia) furnished four arrays for comparison. Each contained some 1500 to 4500 results read on a six-mouse basis. As so long a span of time was included in each, it seemed better to assume that "unprotected" as well as "protected" mortality rates might take the form of frequency distributions. During one run "unprotected" mortality might have a single value; over the course of a year it would almost certainly vary due to changes in virus potency, differences in experimental conditions between runs and the like.

The first step was to make an approximation to the distribution of negative sera by fitting an "endpoint" binomial to the results with 6/6 and 5/6 deaths. The hypothetical frequencies so computed were subtracted from the entire array, leaving a residue which formed the basis for the first approximation to the positive distribution. This residue was fitted with a chain binomial, and the resulting hypothetical distribution was subtracted from the entire array of tests, leaving a residue on which to base the second approximation to the negative distribution by means of a chain binomial. The process was repeated, if necessary, to obtain a reasonable fit.



The results for only one array are shown in detail (Table III)—that of New York laboratory results from May, 1933, through April, 1934. The results of fitting the other arrays of tests were about equally close. Table III shows, for comparison, the results of fitting the same data with a double binomial and a chain Poisson. The chain Poisson,

TABLE III  
OBSERVED AND HYPOTHETICAL MOUSE TEST RESULTS, NEW YORK  
LABORATORY, MAY 1933-APRIL 1934

	Number of Mice Dying							Total	Goodness of Fit (P)
	0	1	2	3	4	5	6		
Observed frequencies	345	135	64	53	111	496	1857	3061	
Hypothetical: "Double Binomial"	317	199	52	13	77	578	1825	3061	0.000000
"Chain Poisson"	331	159	67	44	112	505	1852	3070	0.01
"Chain Binomial"	339	143	71	56	104	500	1854	3067	0.2
Hypothetical distribution of 1000 sera									
{ Negative	—	—	1	6	44	220	730	1000	
{ Positive	585	219	108	53	24	9	2	1000	

like the chain binomial, uses three constants for fitting each of the two populations. The degrees of freedom are so reduced to 1, and the values of "P" are low in view of the apparent closeness of fit. The equations of the two curves of origin for the chain binomials are:

$$\text{Positive sera: } y = 1.9442\pi^{-0.3345}(1-\pi)^{3.4505}$$

$$\text{Negative sera } y = 420.09p^{32.0547}(1-p)^{0.6940}.$$

The last two lines of Table III show the relative expected frequencies of results for positive and negative sera on the basis of the above curves. These values are obtained directly from equation (11) and provide estimates of the probability of a given result being positive. It is evident that a negative serum will almost never show less than 3/6 deaths, while a positive rarely shows more than 4/6. In the intermediate zone, the probability would depend on the total number of positives included in the run. For instance, we may know from the total array that there are ten times as many negatives as positives in a given run;<sup>5</sup> in this case a serum showing 3/6 deaths might be positive or negative with about equal probability.

By substituting the proper value of  $n$  in equation (11) it is possible to calculate the expected positive and negative distributions of test results read on the basis of four or five mice. This gives the elements of a chain binomial of the respective power arising from the curve of origin which was derived from the six-mouse results. The hypothetical

<sup>5</sup> The estimate of the proportion of positives in a run can be made by calculating "U" by the double binomial method. See Table IV.

distributions of results naturally vary with changes in the parameters of the curve of origin. These are not the same for any two of the four arrays of results which were analyzed, but the differences are too small to be of much practical importance in the evaluation of test results.

FIGURE 2  
CURVES OF ORIGIN OF MORTALITY DISTRIBUTIONS

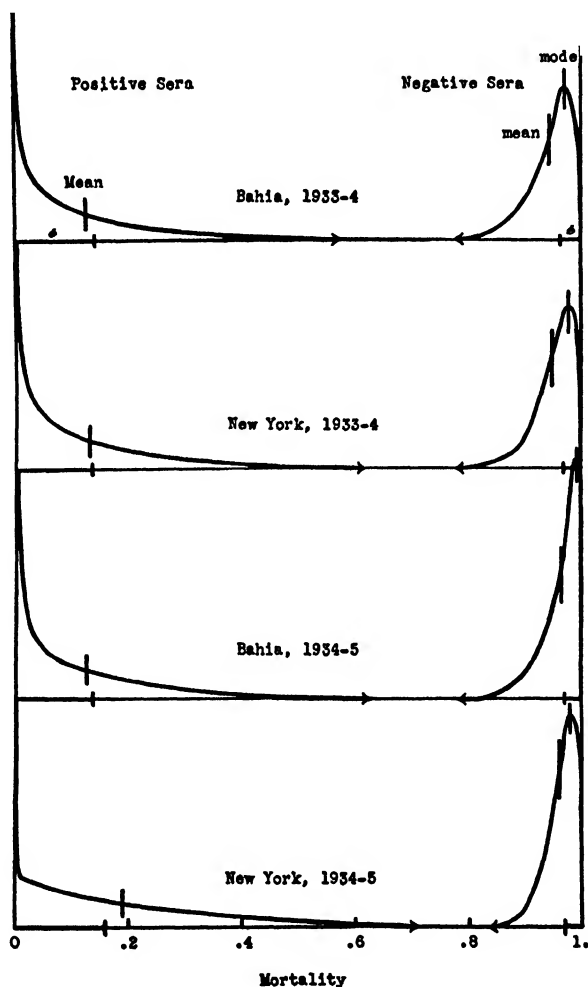


Table IV and Figure 2 show the characteristics of the eight curves of origin obtained from the four groups of tests. The standard deviations measuring the scatter of negative mortalities are much smaller than those of the positive mortalities. The modes of the former curves are appreciably below 100 per cent mortality. Mortalities in “unpro-

tested" mice have apparently risen and become more uniform (as indicated by a smaller  $\sigma$ ) during the second year in both laboratories. This could be due to a rise in virulence of the virus employed, to changes in the technique of the test or to the use of more susceptible strains of mice.

The greatest frequency of positive mortalities is at zero. The constants of the different curves are much alike except for the last one, which shows a markedly greater spread. This might have been the result of the inclusion of a larger number of weakly protective sera in the runs during this year.

The scatter of negative mortalities reflects all experimental variations during the period. That of positives includes all these, plus variations in the protective power of positive sera. If we call the standard deviation of negative mortalities 3.5 per cent and that of positive 14 per cent (see Table IV), then the standard deviation due to the

TABLE IV  
CHARACTERISTICS OF CURVES OF ORIGIN FOR "CHAIN BINOMIAL" FITS

Series	Mortalities among Mice Receiving:								Proportion of Sera Negative ("U")		Number of Tests
	Positive Sera				Negative Sera				Chain Binomial	Double Binomial	
	Mode	Mean	$\sigma$	$\pi^*$	Mode	Mean	$\sigma$	$p^*$			
Bahia, 1933-4	—	0.125	0.142	0.088	0.973	0.945	0.038	0.944	0.801	0.811	1507
New York, 1933-4	—	0.130	0.136	0.095	0.979	0.951	0.037	0.945	0.799	0.812	3061
Bahia, 1934-5	—	0.124	0.137	0.089	0.995	0.963	0.034	0.962	0.820	0.829	4641
New York, 1934-5	0.000	0.190	0.157	0.128	0.980	0.961	0.026	0.958	0.839	0.856	3062

\*  $\pi$  and  $p$  values are those obtained by "double binomial" fit.

variation in positive sera alone would be  $\sqrt{14^2 - 3.5^2} = 13.6$  per cent. The variation in test results introduced by differences in the protective power of positive sera is some four times as great as that due to all other factors together.

Included in Table IV is a comparison of the estimated proportion of negative sera ("U") as determined by the chain binomial and by the double binomial. The values are quite close. In each case "U" by the double binomial is slightly larger, *i.e.*, indicates a slightly lower proportion of positive tests in the entire group. From this it may be concluded that a reasonably accurate and rather conservative estimate of total positives may be obtained by the double binomial in the case of

runs which are too small to be broken down by successive approximations into chain binomials.

#### DISCUSSION

It is evident that the methods derived in this analysis apply equally well to criteria other than survival and death of the animals. This, however, is far the best when it can be used since it is one of the few that do not allow of variability of personal judgment. In any case, the criterion employed must permit only a simple yes-or-no decision.

Nor must the test animals necessarily be mice, though these offer many advantages in cost and in ease of handling. It would probably always be best to use as test animal the one which happened to be most susceptible to the infective agent studied. If this animal, however, turns out to be large and expensive, there can be no accumulation of large numbers of results based on test groups of fair size. At times, as was the case with yellow fever, it is possible to produce a strain of infective agent which is lethal to mice under given circumstances and yet is inhibited by sera of convalescents from attacks by the "free-living" strains.

It is apparent that the foregoing type of study cannot be made on an array of test results based on very small groups of mice. Even six-mouse groups, providing seven "fitting points," leave only one degree of freedom when two chain binomials have been fitted. Four-mouse groups are the smallest that can legitimately be analyzed by the double binomial method. But there would seem to be no good reason why mortality rates or distributions, once determined from arrays of large groups, could not be used to predict the distributions of positive and negative results based on smaller groups of test animals.

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# THE IMPROVEMENT OF STATISTICAL TECHNIQUES IN BIOLOGY\*

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## 1. THE DESIGN OF EXPERIMENTS

THE ENTRANCE of the statistician into the field of experimental design is the most outstanding feature of modern statistics. No more than a decade past, the statistician was distinctly on the defensive. When the data from an experiment were placed on his desk, he was supposed to produce some method of treatment irrespective of design. In some instances he was lucky; in others, baffled. Under the leadership of R. A. Fisher, the statistician has become the aggressor. He has found that the key to the problem is the intimate relation between the statistical method and the experimental plan. The latter must be capable of producing not only an unbiased estimate of the desired effects, but also a valid estimate of error. Many of the plans in use did neither. The statistician is now able to assert that properly designed experiments yield unqualified answers to the questions asked. It is incumbent upon the investigator to plan his experiment in accord with established principles, if he wishes to avail himself of adequate statistical methods. Only if the plan and the method are compatible may unambiguous conclusions be drawn from the statistics. To insure this, the statistical method must be decided upon along with the experimental plan before the laboratory or field work is initiated. The integration of plan and method lead to efficient designs.

## 2. FACTORIAL DESIGN

Among experimental plans brought into prominence by appropriate statistical methods, one which has great logical as well as practical interest is that in which two or more factors in all combinations are investigated in the same experiment. Some description of such a factorial experiment will suffice to indicate its importance. The appropriate statistical methods are well known.

Professor C. S. Reddy of our Botany Department wished to try three levels of a disinfectant designed to destroy *diphtodium* in corn seeds, each at three temperature levels. In addition, he wished to de-

\* A paper presented at the Ninety-seventh Annual Meeting of the American Statistical Association, New York City, December 30, 1935.

termine the effectiveness of a substance intended to prevent injury of the seeds by the disinfectant, this inhibitor being also tried at three levels. In all combinations, there are  $3 \times 3 \times 3 = 27$  treatments, and these are investigated simultaneously in the factorial experiment.

This is a great advantage over the separate trials of the treatments. If only the level of application of the inhibitor were to be varied, some specified amount of the poison at a particular temperature would have to be chosen. The level of inhibitor found suitable under these controlled conditions might be very inefficient under slightly altered conditions of control. The factorial design enables the investigator to determine the optimum combination of poison, inhibitor and temperature. Furthermore, by a method to be indicated in section 4 of this paper, it is easy to learn whether or not the effects are related to the levels in a linear fashion.

The general principles of factorial experimentation are, of course, not new. Recent advances in statistical theory have made clear the experimental plans that must be followed, and have made possible the extraction of much additional information from the results.

### 3. CONFOUNDING

In factorial experiments, when the number of treatments becomes great, the required plots in each block may be so numerous that soil heterogeneity within the block will seriously impair the accuracy of the experiment. The same difficulty would be met if a large number of animals were to be required, all being expected to react alike to uniform treatment. There is a possibility of alleviating this difficulty by dividing the replications into two or more blocks each containing part of the treatments. To a limited extent this may be done without sacrificing any desirable information. The dispensable effects are combined or confounded with block differences.

For illustration, an experiment has been chosen which, though rather oversimplified to be practical, nevertheless exemplifies all the essential principles. Suppose two varieties of maize are to be tested for yield, each treated with two kinds of fertilizer. The four combinations,

$$V_1T_1 \quad V_2T_1 \quad V_1T_2 \quad V_2T_2$$

are to be replicated six times, requiring 24 plots. Suppose, further, that the field is of very uneven fertility so that even four plots, comprising one replication, cannot be placed on uniform soil. Precision may be increased by subdividing each replication into two blocks thus:

Block 1	Block 2
$V_1T_1$	$V_1T_2$
$V_2T_2$	$V_2T_1$

Notice that the assignment to block is along the diagonals of the plat of the four combinations. To understand clearly the effect of this allotment, let the yields of the four plots be denoted as follows:

Block 1	Block 2
$y_{11}$	$y_{12}$
$y_{22}$	$y_{21}$

If block 2 is of superior fertility, let the expected difference in block yield with uniform planting and treatment be  $2d$ . Then an unbiased comparison of the yields might be made in this manner:

Block 1	Block 2
$y_{11} + d$	$y_{12} - d$
$y_{22} + d$	$y_{21} - d$

If these results are now tabulated in an ordinary two-way table, they appear thus:

Variety	Treatment		Total
	$T_1$	$T_2$	
$V_1$	$y_{11} + d$	$y_{12} - d$	$y_{11} + y_{12}$
$V_2$	$y_{21} - d$	$y_{22} + d$	$y_{21} + y_{22}$
Total	$y_{11} + y_{21}$	$y_{12} + y_{22}$	

It is clear that, by the chosen arrangement, the block difference has cancelled in the totals, the varieties and treatments being properly compared with no bias. But the interaction carries a strong bias. Its value is

$$(y_{11} + d) + (y_{22} + d) - (y_{21} - d) - (y_{12} - d) = (y_{11} + y_{22}) - (y_{21} + y_{12}) + 4d.$$

The correct value,  $(y_{11} + y_{22}) - (y_{21} + y_{12})$ , is confounded with the unknown difference in yield attributable to fertility. By this arrangement, therefore, the estimate of interaction is lost, though the main effects are ascertained. If the interaction is of no interest, its loss is immaterial. The compensation comes from the greater precision of the experiment, since the block differences within the replications may now be eliminated from error.

The numerical results from a confounded experiment are recorded in Table 1. The total sum of squares for the 24 plots is computed from the plot yields and recorded in Table 2. The 12 block totals, two in each replication, yield the sum of squares for blocks. The unbiased

TABLE 1  
YIELDS FROM 12 BLOCKS, EACH CONTAINING TWO PLOTS,  
FORMING SIX REPLICATIONS  
Pounds per Plot

Block	Combination	Replication						Total
		1	2	3	4	5	6	
1	$V_1T_1$	11	5	12	15	22	6	71
1	$V_1T_2$	14	6	6	21	15	2	64
Block 1 total		25	11	18	36	37	8	135
2	$V_2T_1$	11	11	15	15	16	11	79
2	$V_2T_2$	12	8	8	11	11	11	61
Block 2 total		23	19	23	26	27	22	140
Replication total		48	30	41	62	64	30	275

total for variety 1 is  $71+79=150$ ; for variety 2,  $64+61=125$ . These are used to compute the sum of squares for variety. In the same way, that for treatment is calculated from the treatment sums,  $71+61=132$  and  $64+79=143$ . Ten degrees of freedom remain for error.

TABLE 2  
ANALYSIS OF THE VARIANCE IN TABLE 1. FIRST ORDER INTERACTION  
CONFOUNDED WITH BLOCK DIFFERENCES

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	23	525.96	
Blocks	11	402.46	
Variety	1	26.04	26.04
Treatment	1	5.04	5.04
Remainder for error	10	92.42	9.24

On account of incomplete randomization in the replications it is impossible to know just what would have been the result if confounding had not been resorted to. It is interesting, however, to go through with the formal computations, with results recorded in Table 3. Insofar as the comparison may be valid, it is notable that the greater number of degrees of freedom for error carry more than a proportionately greater sum of squares. This might be due in part to the inclusion of block differences within the replications. It is also to be observed that the interaction, confounded with block differences in Table 2, is less than average expectation in Table 3.

In his new book, Fisher<sup>1</sup> calls attention to the fact that the ten degrees of freedom for error in Table 2 are composed of five from the six

<sup>1</sup> R. A. Fisher, *The Design of Experiments*. Oliver and Boyd, Edinburgh (1935).



TABLE 3  
ANALYSIS OF THE VARIANCE IN TABLE 1 COMPUTED AS THOUGH THE  
COMBINATIONS HAD BEEN RANDOMIZED IN SIX BLOCKS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	23	525.96	
Blocks	5	280.21	
Variety	1	26.04	26.04
Treatment	1	5.04	5.04
Interaction	1	1.04	1.04
Remainder for error	15	213.63	14.24

blocks numbered one and five from those numbered two. That is, each part of the estimate of error is made up from blocks planted alike. The computations are easily made from the data in Table 1. Among the 12 plots in the first half of the table, five degrees of freedom are assigned to replication and one to combination. The remainder,  $11 - (5 + 1) = 5$ , are identified with interaction, and yield the sum of squares, 69.42. Similarly, the interaction sum of squares from the second half is 23.00. The two make up the total of 92.42 appearing in Table 2.

It is believed that this exposition may serve to introduce the reader to the more extensive and practical designs discussed by Fisher and Yates.<sup>2</sup> In the simple scheme discussed here, there is only one way in which the confounding can be done. In the more elaborate designs, there is a choice. Usually, information about the first order interactions is desirable, and it is the interactions of higher order that are confounded.

#### 4. INDIVIDUAL DEGREES OF FREEDOM

Professor Fisher has insisted that degrees of freedom are individual entities, each with a meaning that may be isolated if interesting. Usually, the separation of a group of degrees of freedom into its component parts is not unique, but the method employed should have a definite objective and should lead to interpretable results. In an important special case, the mechanics of the process are greatly simplified by Fisher's elegant method of fitting curved regression lines.

Dr. A. E. Brandt of our laboratory has furnished me with an illustration of an analysis which I think is destined to play an important rôle in experimentation with dairy cows. The effect of any treatment presumed to affect milk flow is complicated by the normal cycle of production. To meet this difficulty, the treatment is applied periodi-

<sup>2</sup> F. Yates, "Complex Experiments," *Supplement to the Journal of the Royal Statistical Society*, 2: 181 (1935).

cally, the results being compared with those from the untreated inter-period. More usually, two treatments are alternated in the periods and their effects compared. The data from such an experiment are recorded in Table 4. The analysis of the variance, Table 5, is computed in the usual manner.

TABLE 4  
AVERAGE DAILY MILK PRODUCTION (POUNDS) OF FIVE COWS IN THREE EXPERIMENTAL PERIODS DURING WHICH INDICATED RATIONS WERE FED

Cow Number	Period 1 High Fiber	Period 2 Low Fiber	Period 3 High Fiber	Total
855	25.92	20.84	18.84	65.60
867	46.10	41.26	26.42	113.78
943	43.28	32.80	28.12	104.20
1039	44.54	39.54	34.08	118.16
1066	57.62	45.84	35.70	139.16
Total	217.46	180.28	143.16	540.90

It is clear that the interest of the investigator lies in the linearity or non-linearity of the milk production in the three periods. If the change of treatment had any effect, it must be revealed by the failure of the production in the middle period to fall on the regression established by the beginning and final periods. The appropriate tests of significance are got by dividing the two degrees of freedom for period

TABLE 5  
ANALYSIS OF VARIANCE OF DAILY MILK PRODUCTION OF FIVE COWS IN THREE EXPERIMENTAL PERIODS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Total	14	1,626	
Between cows	4	973	243
Between periods	2	552	276
Interactions	8	101	13

into one representing linear regression and one for deviations from such regression, then making a corresponding division of the 8 degrees of freedom for interaction. The results are presented in Table 6. Two tests of significance may be made: (i) Between periods, linear regression, against interactions, linear regression;  $F=552/19=29$ , a significant value, but uninteresting in this case. There is never any question about the decrease of milk flow with advance of the reproductive cycle. (ii) Deviations in the two sources,  $F=0$ . This is the important information desired. The change in rations had no appreciable effect.

## 5. CORRELATION ATTRIBUTABLE TO COMMON ELEMENTS

This is certainly not a new subject, but may well be given more, and more serious, consideration than heretofore. The earliest publication I have found is in an article by Spearman.<sup>3</sup> However, this method of explaining correlation seems to have been used at or before that

TABLE 6

ANALYSIS OF THE VARIANCE BETWEEN PERIODS AND INTERACTION IN TABLE 5 INTO TWO PORTIONS EACH, ONE FOR LINEAR REGRESSION AND THE SECOND FOR DEPARTURES THEREFROM

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square
Between periods:			
Linear regression	1	552	552
Deviation	1	0	0
Interactions:			
Linear regression	4	77	19
Deviations	4	24	6

time by Weldon,<sup>4</sup> being referred to in Brown's doctoral dissertation<sup>5</sup> as "Weldon's experiment." Aspects of the theory have been discussed by Kapteyn,<sup>6</sup> Brown and Thomson<sup>7</sup> Rietz,<sup>8</sup> Karl Pearson,<sup>9</sup> Carl H. Fischer,<sup>10</sup> and others. Rather inadequate references to it have recently appeared in several elementary texts. I am convinced that many ill-founded ideas, almost superstitions, about correlation will be abandoned when this interpretation is more generally understood.

Consider a population of numbers. For simplicity, they may be normally distributed, though Carl Fischer has shown that the distribution may be described in more general terms. For convenience, also, let the mean be zero and the standard deviation, unity. Draw a random sample of  $N$  of these normal deviates, thus:—

$$V_1, V_2, \dots, V_{N-n_1}, V_{N-n_1+1}, \dots, V_{n_1}, \dots, V_N.$$

Designate by  $x_1$  the sum of the first  $n_1$  of these items, and by  $x_2$  the

<sup>3</sup> C. Spearman, "The proof and measurement of association between two things," *American Journal of Psychology*, 15: 72 (1904).

<sup>4</sup> W. F. R. Weldon, "Inheritance in animals and plants," in *Lectures on the Method of Science*. Edited by T. B. Strong. Clarendon Press, Oxford (1906).

<sup>5</sup> William Brown, *The Essentials of Mental Measurement*. The University Press, Cambridge (1911).

<sup>6</sup> J. C. Kapteyn, "Definition of the correlation-coefficient," *Monthly Notices of the Royal Astronomical Society*, 72: 518 (1912).

<sup>7</sup> William Brown and G. H. Thomson, *The Essentials of Mental Measurement*. The University Press, Cambridge (1921).

<sup>8</sup> H. L. Rietz, "A simple non-normal correlation surface," *Biometrika*, 24: 288 (1932).

<sup>9</sup> Karl Pearson, "Professor Rietz's problem," *Biometrika*, 24: 290 (1932).

<sup>10</sup> Carl H. Fischer, "On correlation surfaces of sums with a certain number of random elements in common," *The Annals of Mathematical Statistics*, 4: 103 (1933).

sum of the last  $n_2$ . Assuming that  $n_{12} = n_1 + n_2 - N$  is a positive number, then  $n_{12}$  of the elements are common to the sums  $x_1$  and  $x_2$ . Repeat this process *ad libitum*. The correlation between  $x_1$  and  $x_2$  is,

$$r_{12} = n_{12}/\sqrt{n_1 n_2},$$

and the regression of  $x_1$  on  $x_2$  is,

$$\bar{x}_1 = (n_{12}/n_2)x_2.$$

Further,  $n_1$  and  $n_2$  are the variances of  $x_1$  and  $x_2$ .

To extend the above ideas to include multiple regression, the random sample may be subdivided into three groups of items whose sums are  $x_1$ ,  $x_2$  and  $x_3$ , with  $n_{12}$ ,  $n_{13}$  and  $n_{23}$  random elements common respectively to  $x_1$  and  $x_2$ ,  $x_1$  and  $x_3$ ,  $x_2$  and  $x_3$ . It can then be shown that the correlations are of the form,

$$r_{12} = \frac{n_{12}}{\sqrt{n_1 n_2}} + \frac{n_{13}}{\sqrt{n_1 n_3}} \cdot \frac{n_{23}}{\sqrt{n_2 n_3}},$$

the extra term being due to the elements passing from  $x_2$  to  $x_1$ , not directly, but through  $x_3$ . Furthermore, the standard regression coefficients are like this,

$$\beta_{12.3} = n_{12}/\sqrt{n_1 n_2},$$

and the regression equation may be written,

$$\begin{aligned}\bar{x}_1 &= \frac{n_{12}}{\sqrt{n_1 n_2}} \cdot \frac{\sqrt{n_1}}{\sqrt{n_2}} \cdot x_2 + \frac{n_{13}}{\sqrt{n_1 n_3}} \cdot \frac{\sqrt{n_1}}{\sqrt{n_3}} \cdot x_3 \\ &= (n_{12}/n_2)x_2 + (n_{13}/n_3)x_3.\end{aligned}$$

I can merely suggest the type of inquiry now laid open to investigation. First, consider the moot question as to the "determination" of  $x_1$  by  $x_2$  and  $x_3$ . Ezekiel<sup>11</sup> suggested the quantities  $r_{12}\beta_{12.3}$  and  $r_{13}\beta_{13.2}$  as "coefficients of separate determination," since their sum is  $R^2_{1.23}$ . But, in terms of common elements, these are complicated expressions, in no way specifying the numbers of elements common to the dependent and independent variables. Again, Wright<sup>12</sup> presented a "coefficient of determination,"  $\beta^2_{12.3}$ , but later withdrew the suggestion.<sup>13</sup> Wallace and Snedecor<sup>14</sup> used merely the standard regression coeffi-

<sup>11</sup> Mordecai Ezekiel. *Methods of Correlation Analysis*. John Wiley and Sons, Inc., New York. Page 380 (1930).

<sup>12</sup> Sewall Wright, "Correlation and causation," *Journal of Agricultural Research*, 20: 557 (1921).

<sup>13</sup> Sewall Wright, "The method of path coefficients," *Annals of Mathematical Statistics*, 5: 165 (1934).

<sup>14</sup> H. A. Wallace and George W. Snedecor, "Correlation and machine calculation," *Iowa State College Official Publication*, 30: No. 4 (1931).

cients; but these give the information desired only if  $n_1 = n_2 = n_3$ . It turns out, however, that the assumption of the equality of these numbers is usually necessary in order to identify the method of common elements with any actual situation. Apparently, these standard regression coefficients are as good an estimate as any available for judging the relative potency of  $x_2$  and  $x_3$  in affecting  $x_1$ , but the idea should be used with due caution as to its limitations.

Another interesting interpretation of correlation is Wright's<sup>15</sup> coefficient of determination of outside causes,  $d_{x \cdot o}$ . In the simple case of two variables, this is  $1 - r^2_{12}$ , which for common elements is  $1 - n^2_{12}/n_1 n_2$ . I have tried to identify this with some function of the non-common elements,  $n_1 - n_{12}$  and  $n_2 - n_{12}$ , but have not succeeded in the general case. In two particular cases, the results are interpretable. (i) If all the elements in  $x_2$  pass to  $x_1$  then  $n_2 = n_{12}$ , and consequently  $d_{x \cdot o} = 1 - n_{12}/n_1$ , the fraction of elements in  $x_1$  not common to the two variables. (ii) If all the elements in  $x_1$  are received from  $x_2$ , then  $d_{x \cdot o} = 1 - n_{12}/n_2$ , the fraction of elements in  $x_2$  not passing into  $x_1$ . The interesting feature of these interpretations is that the outside influences may enter the system either through  $x_1$  or  $x_2$ , but not through both. With more than two variables, the situation becomes much more intricate.

An example of a common interpretation of correlation which is, in a special case, justified by the theory of common elements is the statement that, "The correlation  $r_{12}$  is the fraction of causes common to  $x_1$  and  $x_2$ ." The special case is that mentioned before, in which the number of elements is assumed to be the same in  $x_1$  and  $x_2$ . If  $n_1 = n_2$  then  $r_{12} = n_{12}/n_1$ . When using this interpretation, it should be understood that the "causes" are not only equal in number, but must be of uniform weight in the sense that they must be random elements in a specifiable population.

## 6. TESTING IN COVARIANCE

There was a tremendous spurt of interest in covariance beginning a couple of years ago. Correlation method always excite the imagination. Methods of testing crowded each other's heels; Bartlett,<sup>16</sup> E. S. Pearson,<sup>17</sup> Welch,<sup>18</sup> and Wishart<sup>19</sup> published in rapid succession, while

<sup>15</sup> Sewall Wright, *loc. cit.* (1921).

<sup>16</sup> M. S. Bartlett, "The vector representation of a sample," *Proceedings of the Cambridge Philosophical Society*, 30: 327 (1934).

<sup>17</sup> Appendix to paper by E. S. Wilcoxon, "Discrimination by specification statistically considered and illustrated by the standard specification for Portland cement," *Supplement to the Journal of the Royal Statistical Society*, 1: 180 (1934).

<sup>18</sup> B. L. Welch, "Some problems in the analysis of regression among  $k$  samples of two variables," *Biometrika*, 27: 145 (1935).

<sup>19</sup> John Wishart and H. G. Sanders, *Principles and Practice of Field Experimentation*. The Empire Cotton Growing Corporation, London (1935).

Fisher's revised text<sup>20</sup> included the test appropriate to certain planned experiments. It seemed that the complications would be almost too great to be mastered by the layman. Numbers of hypotheses were set up, each requiring its appropriate test. It was with much trepidation that I suggested the simple form outlined in my paper at the last meeting of this Association.<sup>21</sup> It seems, now, that this easy method has rather wide application. It may be used at least in a preliminary examination, to be followed by more specialized tests if required. However, we have tried it in numerous analyses during the past year, and have found it adequate. The problem of testing in covariance seems to be about solved. Fortunately, the non-professional user of statistics may proceed with almost the same security as he feels in testing variance. When working with data from a planned experiment, such as a block-variety or Latin square, he should use the appropriate method as given in Fisher's book. In preliminary studies of correlated data from casual sources, he should use the method which I proposed last winter. If critical questions arise, he may be compelled to test some of the more specialized hypotheses given in the references listed.

#### 7. FACTOR THEORY

You may be surprised to hear this theory mentioned in connection with biological statistics. Professor Thurstone suggested to us that it might have applications other than the examination of test scores. We have used it in an investigation of a group of correlations among various characters in soybean plants, including height, numbers of nodes and pods, seeds per pod and yield. When Weatherspoon and Wentz<sup>22</sup> published these data, they made the suggestion that all the variates probably were expressions of plant vigor. Miss Gertrude M. Cox of our laboratory has applied the factor theory to the correlations with some interesting results.

Three rather well defined general factors segregate. (i) Vegetative growth, highly correlated with height and number of nodes. This is the character most sensitive to environmental conditions. (ii) Reproduction, with its associated variates, number of pods, and pods per node. This is another physiological character, dependent upon environmental conditions for its initiation, but responding to a different set of internal conditions from that favoring the first factor. (iii) Inherited characteristics such as seed size and seeds per pod. These respond less

<sup>20</sup> R. A. Fisher, *Statistical Methods for Research Workers*. Oliver and Boyd, Edinburgh (1934.)

<sup>21</sup> George W. Snedecor, "Analysis of covariance of statistically controlled grades," *This JOURNAL*, 30: 263 (1935).

<sup>22</sup> J. H. Weatherspoon and J. B. Wentz, "A statistical analysis of yield factors in soybeans," *Journal of the American Society of Agronomy*, 26: 524 (1934).

freely to environment, being under ordinary conditions almost independent of it.

In this analysis, yield turns out to be a factor common to, and positively associated with all the others. It partakes freely of both environmental and hereditary influences. The three general factors, however, are rather sharply differentiated in their relationships. I am indebted to Dr. W. E. Loomis, plant physiologist of our Botany Department, for the interpretation of these results. Apparently, the elaborate numerical analysis associated with the factor theory is capable of isolating something objective, and this is welcome information. Whether the method will have any practical applications in biology, I cannot say.

We have another interest in the factor theory. With the mechanism of common elements at hand, using a technique similar to that of Brown and Thomson,<sup>23</sup> we could design a set of variables correlated with each other in a known manner, or independent of each other; also correlated with both general and specific factors in the same predetermined fashion. Miss Cox then applied Thurstone's method, obtaining completely satisfactory verifications of the theory. The determination of the factors is, of course, approximate; but the precision was most pleasing. Incidentally, the whole process of setting up and solving the problem by common elements was of indispensable educational value to us.

#### 8. THE REJUVENATION OF CHI-SQUARE

No review of the improvement of statistical techniques in biology would be complete without mention of the advances made during recent years in the utility of chi-square. Designed by Karl Pearson<sup>24</sup> for a highly specialized purpose, it has, in the hands of R. A. Fisher, become the basis of a statistical method of major importance. Fisher says,<sup>25</sup> "This, I believe, is the great contribution to statistical methods by which the unsurpassed energy of Professor Pearson's work will be remembered." It is coming to be generally recognized that chi-square is the test of significance appropriate to the enumeration data characteristic of the study of attributes. To convert such data into percentages or other ratios and study them as measurements of a continuous variate is not only to substitute an approximate method for an exact one, but is to waste a lot of good information contained in the data. Analysis of enumeration data with the aid of chi-square is almost as systematically done as analysis of variance.

<sup>23</sup> William Brown and G. H. Thomson, *loc. cit.*, p. 896.

<sup>24</sup> Karl Pearson, "On the criterion that a given system of deviations . . . can be reasonably supposed to have arisen from random sampling," *Philosophical Magazine*, Series 5, 50: 187 (1900).

<sup>25</sup> R. A. Fisher, *loc. cit.*, page 23 (1934).

I shall illustrate my point through means of some data, Table 7, made available to me by Mr. J. F. Kagy of our Zoology Department. He was investigating the effects of three insecticides applied to San José scale. The insects infested branches of apple trees near Ames, Iowa. Each branch was cut into three segments, one of which was treated with each of the insecticides. If analysis of variance were used, the assumption would have to be made that the second order interaction is a valid estimate of error. The proper analysis, by means of chi-square, requires a method for isolating this second order interaction, a problem which has been solved only for a special case.<sup>26</sup> However, a comparatively simple approximation seems ample to indicate a sig-

TABLE 7  
ACTUAL AND ESTIMATED NUMBERS OF SAN JOSÉ SCALE KILLED  
BY THREE INSECTICIDES IN SUBSAMPLES OF 60,  
TOGETHER WITH VALUES OF CHI-SQUARE\*

Segment	Insecticide A			Insecticide B			Insecticide C			Total	
	Dead	Esti- mated	$\chi^2$	Dead	Esti- mated	$\chi^2$	Dead	Esti- mated	$\chi^2$	Dead	$\chi^2$
1	32	30.630	0.06	47	45.589	0.04	51	53.781	0.14	130	0.25
2	39	34.635	0.55	51	51.551	0.06	57	60.814	0.24	147	0.85
3	38	33.929	0.49	51	50.498	0.01	55	59.573	0.35	144	0.84
...	...	...	...	...	...	...	...	...	...	...	...
17	30	28.038	0.14	37	41.731	0.54	52	49.230	0.16	119	0.83
Total	516		10.04	768		4.36	906		4.67	2,190	19.06

\* From data furnished by J. F. Kagy of the Zoology Department of Iowa State College.

nificant heterogeneity in the present data. Each sub-class in the table is supplied with an expected number by known methods.<sup>27</sup> The same is done for the numbers alive. Usually, the two expected numbers, dead and alive, do not add to the required 60 insects, so that an adjustment must be made to remedy this difficulty. Then the contributions to chi-square are calculated in the usual manner. The resulting sum, 53.4 based on 32 degrees of freedom, has a probability of occurrence in random samples from a homogeneous population of only 1.6 per cent. Although the amount of heterogeneity in this case is apparently not serious, and although analysis of variance yielded much the same tests of significance as did chi-square, it is to be hoped that a practicable method may be forthcoming for the exact estimation of interaction in such a three-way table.

<sup>26</sup> M. S. Bartlett, "Contingency table interactions," *Supplement to the Journal of the Royal Statistical Society*, 2: 248 (1935).

<sup>27</sup> George W. Snedecor, "The method of expected numbers for tables of multiple classification with disproportionate subclass numbers," *This JOURNAL*, 29: 389 (1934).



## INDUSTRY STATISTICS IN MARKETING MANAGEMENT

BY S. J. KENNEDY  
*Pacific Mills*

**O**PPORTUNITIES for the use of industry statistics in determining marketing and production policies are exceptionally numerous in the textile industries because of the character of the dominant supply and demand factors in textile markets. Properly speaking, there is no "textile industry" nor even a "cotton textile industry" in the sense that industry statistics for such large groupings have much genuine usefulness to individual firms in the industry. Economists on the outside may find some use for statistics of that type, but what cotton mill management needs—and probably the same is true in other industries as well—are statistics for much finer groupings; in short, statistics which indicate current conditions and trends in specific markets. In the textile trades, the term "market" is generally applied to the buyers and sellers of a group of fabrics closely related in character and produced upon the same specific equipment, or by the same type of mills, which tend to be sold interchangeably to more or less the same group of purchasers. In the cotton woven goods branch of the industry, for example, there are approximately 150 individual markets, 35 grey goods markets, about 60 finished goods markets, and about 50 fabricated product markets.

Following this concept further, it can be seen that the textile industries as a whole comprise a system of interrelated markets closely held together by strong tendencies on the demand side toward substitution of one fiber for another, and of one fabric for another; and on the supply side by the potential transferability of a large part of the total equipment in the industry from producing goods sold in one market to products of other markets. This interrelationship contributes to a high degree of elasticity of supply and demand for certain types of goods, while for other types, supply and demand may be highly inelastic.

In either case, it is of the utmost importance for management to have statistical data on supply and demand conditions in the particular markets for which its products are intended. Not that without such statistics management would be unable to act, for statistics are frequently not available in sufficient time to indicate market trends, but to confirm quantitatively trade reports of a qualitative nature which must frequently be the sole basis for marketing decisions.

For the analysis of short-term supply and market demand, Trade Association statistics of production, stocks, unfilled orders and shipments have come to be invaluable guides to management, even in the textile industries. There are, of course, still a substantial number of mill executives whose management methods are too completely guided by hunches for them to see a dollars-and-cents value in industry statistics above the small cost of reporting their own figures. In some branches of the textile industry, the percentage of firms unwilling to report statistical data to the Trade Association is large enough to affect seriously the value of such industry statistics. There the periodical biennial check afforded by the Census of Manufactures production figures is invaluable as an indication of the real significance of Trade Association data for any given specific market.

With statistics of current market conditions as revealed in weekly Trade Association data, we are less concerned here than with industry statistics of a long-term character which may be used for determining basic trends in distribution both in the demand for specific products and the channels of distribution for those products.

Statistics of unfilled orders and stocks on hand are invaluable for analyzing market demand factors for short-term periods, but throw little light upon consumer demand which is essentially long-term in its operation, and for purposes of marketing control is frequently the more important aspect of demand. In the final analysis, consumer demand for fabrics to satisfy textile uses is met by the products of a number of different fibers: cotton, silk, filament rayon, spun rayon, wool, jute, paper, etc. Continual shifts are taking place between these fibers, due in part to competition between them based upon both price and consumer preference. In addition, within the group of fabrics produced from the same fiber, continual shifts are occurring from one fabric to another, due to style trends and price bracket requirements.

The determination of these trends in substitution is a fundamental problem in textile marketing management. Markets may either be shrinking in size or growing. Complete dependence upon trade contacts and trade news for information about relative trends in markets may be adequate for a small converter with only limited capital and a handful of customers, but for a large organization with heavy fixed investment, a more complete picture of the market which can be confirmed statistically is definitely needed.

From a production management point of view, the need for this information is further enhanced by the transferability of a large part of the total producing equipment in the industry to the products of other markets. It is probable that in the cotton woven goods branch of the

industry, as many as two-thirds of the looms can be converted to producing other types of products than those on which they normally operate, with only a moderate amount of readjusting required. For mills with specialized equipment which can produce only a limited range of merchandise, the need for adequate information on long-term market trends is even more necessary.

Furthermore, trade news is frequently subject to propaganda used to bolster up the confidence of retail and consumer channels in types of goods for which the consumer market is actually shrinking. In a declining market a mill may be obtaining a continually increasing share of the total market so that the fundamental downward trend may not be apparent, and as a result, the mill may overstay the market, continuing to produce goods at a rate unjustified by the decreasing size of the market. The fact that the market appears to be continuing on an even level may deceive the management and lead it to stay on in the field while its competitors may have shifted to more profitable lines.

On the other hand, a firm may be losing business in a specific market at a rate faster than the actual decline of the market, with the result that the management may tend to attribute its poor merchandising job to lack of demand for goods of that type. Based on such conclusions, a shift of producing equipment to other products or the actual shutting down of the mill may be undertaken prematurely. Conversely, in a growing market a mill which is holding its own or increasing its volume at a lower rate than the actual expansion of the market, may feel that it is doing a good job, whereas actually it should be doing a much better merchandising and selling job.

In the past it has been exceedingly difficult to obtain significant statistics which would reveal market trends, or even to lay bases for estimates that would reveal trends. However, in the last few years, definite and important progress has been made in improvement of this data and the basis has been laid for further compilation of significant data on specific textile markets. Statistics of total production in specific textile markets will be available when the 1935 Census of Manufactures data are published. These data, together with trade association statistics of production in those markets, will provide a body of data which can be used for this type of analysis such as this industry has never had available before.

This same line of approach can frequently be used to determine not only the existence of certain trends in the shrinkage or growth of a given market, but also upon careful analysis, to indicate the causes of those trends. To indicate, for example, that the rayon dress fabric

market among manufacturers producing dresses to wholesale at \$2.25 to \$3.75 each is expanding along certain measurable lines is not enough. Where is the consumer demand coming from? Is the dress market getting a larger share of the consumer dollar? Or if consumer income is increasing, is the share going to the dress market simply proportionate to this increase? Or is a substitution of rayon fiber for cotton, silk, and wool occurring, and if so, to what extent is each being affected by growth in the demand for rayons?

Unless competition in a broad market like the women's dress fabric market is direct, the existence of competition between one fiber and another may not be detected for a long time. For example, as has recently been determined, the expansion of filament rayon consumption took place at the expense of cotton far more than at the expense of silk; but since its competition with cotton was indirect—that is, not on a price basis, so much as on a use basis, with a rayon dress substituting for one or more cotton dresses even though the latter were selling at a lower price, since a rayon dress is usable for more occasions and a longer period during the year—the cotton goods market was not aware of the extent of this consumer substitution even though there was a vague feeling that demand for their product was being curtailed. Likewise, the current expansion in spun rayon fabrics will undoubtedly occur over the near future in much the same manner—that is by indirect competition. Probably wool and cotton will feel this competition most severely, but since the price ranges in which spun rayon garments will be sold will be higher than those of cotton and much lower than those for wool, it will be difficult for producers of those two types of goods to get at grips, so to speak, with this competition and to know to what extent this new fiber is cutting in on their markets.

It is for the solution of such problems which involve fundamental marketing and production policies that industry or market statistics have their greatest value. Study of trends in a number of closely related markets will frequently reveal the extent, character and cause of shifts from one to the other.

But beyond the problem of trends in the market itself is the closely related problem of trends in channels of distribution. Just now in the department store field there are endless conferences being conducted to discuss the decline of piece goods sales. If one-tenth or even one per cent of the money represented by the time of high priced executives who get together to discuss this problem were invested in worth-while statistics by some one interested in them not as propaganda for some previously determined course of action, we would soon have the data needed to know what is actually happening in the piece goods field,

where it is occurring and how to go about correcting it intelligently.

If such statistics of trends in distribution channels of specific markets were made available, we should perhaps be spared the welter of argument over trends in dry goods wholesaling. Over the past ten years there has been enough discussion of the decline of dry goods wholesaling to fill a good sized library. Just recently we have witnessed an amazing attack in the press upon wholesale dry goods distribution by a leading chain store executive and a reply by a wholesaler whose use of statistics in his reply was not less amazing. The facts, of course, are somewhere in between, but it would be a relief to have them available so that there would be something more definite for laymen to go by.

In the field of distribution, a worth-while start has been made by the Bureau of Census in what is now called the Census of Business. Whereas production data collected by the Census are fairly well supplemented by trade association statistics within the limitations indicated above, there is little available among textile trade associations in distribution statistics. From time to time associations like the Cotton Textile Institute and the former Wool Institute have attempted to collect data in this field, but either lack of funds or unwillingness of many firms to keep statistics of their own on distribution, or the complexity of the textile market system itself has militated against the collection of a significant body of data on distribution in practically all textile markets.

Here the same selling job which trade associations originally had to undertake to convince their members of the value of production statistics must eventually be undertaken with distribution statistics where the benefits are more in the long run rather than nearby, whereas textile executives never have been and are not now accustomed to basing judgments habitually upon long-term values. The educational work on the value of statistics accomplished during the code period under intelligent leadership in the various branches of the industry undoubtedly laid a foundation for future expansion in the use of textile statistics.

The use of industry statistics for determining long-term market trends in demand for specific products and in channels of distribution along the lines which have been indicated above, represents only one, but an important application of statistics dealing with specific industries or markets.

It must be realized, however, that for valid conclusions to be drawn, the basic data, must be expressed in terms of totals for the industry, not samples, since the number of firms represented is seldom large

enough, nor their production uniform enough for it to be possible to estimate the total from any arbitrarily selected sample. It is for this reason that industry data compiled by Trade Associations must be continually checked, even though tardily, against totals collected by the biennial Census of Manufactures. Without such periodic check in terms of totals, this type of industry analysis, which has been outlined above, becomes impossible. Accordingly, for the Census of Manufactures to serve its most useful purpose in this field, its classifications must be similar to the classifications used by accredited Trade Associations in their respective fields.

Proposals to make the Census of Manufactures product data less detailed than is required to show production in the industry's separate markets, or to issue it less frequently, would diminish its usefulness in more than geometrical proportion to the extent of the reduction made. If industry cannot obtain the kind of product data that has a definite meaning in terms of industry statistics, the collection of data in broader classifications represents simply a waste of time and money both on our part and the Government's.

It is of the highest importance, if Government agencies are to justify the continual collection of statistics from industry for whatever purpose, and the substantial expenditures which they require of reporting firms, that a genuine effort be made, first, to see that the data will serve a definite constructive end, and second, that the results will be of direct value to those who furnish it. The extension of these principles among Government agencies will go a long way toward diminishing some of the feeling of futility which generally overwhelms those who have to fill out Government questionnaires. Far more important, if coupled with prompt and complete publication of the reported data, it will facilitate definite progress in the collection of a type of statistics that industry is coming more and more to value.

## DEVELOPMENT OF THE POSTAL SAVINGS SYSTEM

BY LOUISE SISSMAN

**T**HE United States Postal Savings System was established in 1911 after continued agitation for half a century. It was originally proposed as a charitable institution for fostering thrift among the poor and later was urged as a means of attracting the savings of immigrants and of hoarders who either were too awed by the elaborate bank buildings to feel their small savings would be welcome or who actually distrusted the safety of the banking institutions. The panic of 1907 greatly augmented the group distrusting the banks and the demands for a government guaranty of bank deposits or, as a substitute, a government guaranteed depository, gave very considerable weight to the movement for the introduction of a Postal Savings System.

Nevertheless, the Postal Savings System did not immediately become popular. After a year and a half of activity, less than 245,000 persons had availed themselves of the facilities of the System and, although during the next few years depositors continued to increase steadily, the movement was anything but spectacular. By 1917 the number of depositors reached a peak of 675,000 persons and then actually began a decline which was at first almost as steady as the growth in the previous years. As a result, in 1930, after twenty years of operation the number of depositors was only 466,000. At the same time the owners of bank savings accounts numbered 52,000,000.

The movement in deposits was similar. Despite several relaxations of the law limiting the amount receivable from one person, the amount on deposit grew so slowly that by 1930 it was only \$175,000,000, less than one per cent of the \$27,000,000,000 of savings deposits then in banks. For the country as a whole, in 1930 bank savings deposits averaged \$221 per inhabitant, while Postal Savings accounts averaged less than \$1.50.

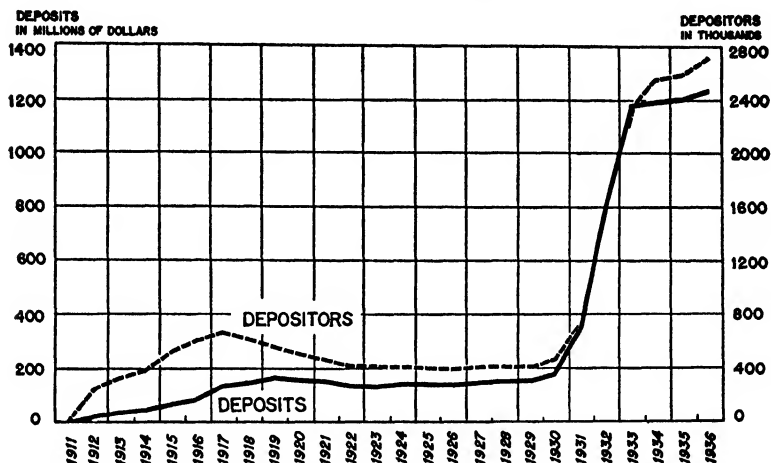
Suddenly, in 1930 this lethargy vanished and within three years the Post Office witnessed the growth of its depositors to 2,342,000 and its deposits to \$1,187,000,000 increases of 400 per cent and 575 per cent, respectively. These changes are shown in Chart I.

### IMPORTANCE OF POSTAL SAVINGS

Despite this rapid development the Postal Savings System is still of relatively small importance when considered as a type of savings in-

stitution. It has only 6 per cent of the savings depositors in the country and 5 per cent of the savings deposits. The 571 mutual savings banks have eight times the deposits held by the Post Office.

CHART I  
POSTAL SAVINGS DEPOSITS AND DEPOSITORS  
June 30, 1911-June 30, 1936



When, however, the Postal Savings System is viewed as a single organization with centralized control, the Post Office stands out clearly as our largest single organization for the collection of savings deposits.

TABLE I  
POSTAL SAVINGS SYSTEM AND BANKS RECEIVING SAVINGS DEPOSITS  
June 29, 1935

Class of institution	Number of offices		Amount in savings deposits (000,000 omitted)	Number of savings accounts
	Head offices	Branches		
Postal Savings System	1	8,036*	\$1,202	2,587,128
Mutual savings banks	571	133†	9,902	13,213,211
National banks	5,431	1,327†	6,363	14,338,780
State banks	8,480		2,509	6,810,471
Stock savings banks	341	1,772†	715	1,359,414
Loan and trust companies	1,007		2,309	4,723,553
Private banks	243	8†	41	32,186

\* Post Offices and branches designated to receive Postal Savings deposits.

† December 31, 1935.

Source: Number and amount of savings deposits in banks—*Annual Report of the Comptroller of the Currency for 1936*, pp. 116-121.

Number of banks—*Ibid.*, p. 100.

Number of branches—*Federal Reserve Bulletin*, April, 1936, p. 304.

Note: Statistics of Postal Savings throughout this paper are based on data in the annual reports of operation of the Postal Savings System and are for the Continental United States only.



Its nearest rival is the Bowery Savings Bank whose total deposits amount to \$500,000,000, less than half that of the Postal Savings System. Nor can any banking organization compare with the Post Office in geographic importance. While the issue whether banks should have branches has been contested in practically every state of the Union, the Post Office has quietly established an unsurpassed branch savings system. With offices located in cities large enough to have hundreds of banks and in hamlets too small to support even one bank, the Postal Savings System is able to reach more customers than any other financial organization. In many communities it is the only institution available for the collection of savings.<sup>1</sup> In 1935 the Post Office had more than 8,000 offices providing facilities for savings accounts in over 7,200 communities in every State. The largest branch banking system, the Bank of America, N. T. & S. A., on the other hand, had about 430 branches active in one state only.

With such a large nation-wide system, many of the problems inherent in a branch organization are present in magnified form. Branch systems have been accused of draining funds from local communities; of encouraging investments in securities as opposed to local loans; of being rigid in their regulations which are relatively uniform for all offices, sometimes without regard for exceptional local conditions; of tending to become bureaucratic; and of offering unfair competition to local business due to their size. Up to 1933 most of these problems were dormant in the Postal Savings System. Postal Savings funds were in the main redeposited in local banks, thereby becoming indirectly deposits in either local banks or relatively small branch systems which could make the money available to local communities through loans. Since 1933, however, the banks have in considerable numbers begun to refuse Postal Savings funds and the biggest part of the money has been transferred to Washington for investment in securities. This has brought to life many of the issues involved in a branch system.

Because the law has restricted the lines of activity of the System, these questions have not as yet become acute. Nevertheless they seriously merit study. The set-up of the System is such as to render it readily available for an extension of powers should Congress decide to do so. The potentiality for rapid growth, moreover, which was demonstrated by the sudden rise in three years from deposits of \$175,000,000, to \$1,187,000,000, without any advertising, demonstrates that Postal Savings may quickly and readily be used to exercise considerable influence in our banking system. For these reasons it is well

<sup>1</sup> In 1934 there were Postal Savings depositories in about 2,250 communities which either had no bank or no bank whose deposits were insured by the Federal Deposit Insurance Corporation.

to study the Postal Savings System with a view to directing intelligently its future operations. This particular article is confined to an analysis of the changing type of Postal Savings depositors and the principal factors which have brought about this change.

#### CHANGING CHARACTER OF POSTAL SAVINGS

The rapid increase in Postal Savings deposits during the period 1930-1933 has been attributed to the bank failures of that time and appears to be in direct contrast with the preceding decade during which Postal Savings showed little change. What has not been recognized is that the forces which brought about this sudden growth were at work during earlier years. A close examination of the statistics of the period prior to 1930 discloses that Postal Savings were undergoing important changes throughout the country for at least a decade but these changes were obscured by the existence of opposing local trends which counter-balanced each other and were, therefore, hidden in the totals for the country.

To analyze these changes in detail and to determine, in so far as possible, the causes for them, three extreme dates have been chosen: 1920, 1930, and 1933. From Chart I above it will be seen that 1920 and 1930 are at the beginning and the end of the supposedly stationary decade, while 1933 marks the end of the ensuing period of rapid growth.

#### GEOGRAPHIC DISTRIBUTION<sup>2</sup>

The popularity of Postal Savings has always varied markedly in different parts of the country. By 1920, long after the Postal Savings System had passed through its trial years, there were 506,000 depositors with \$157,000,000 on deposit. A detailed examination of Table II shows that at that time Postal Savings was used most, proportionately to the population, in the industrial northeast and the West, along the two seaboard. The states using Postal Savings the least in proportion to their population were in the central and southern part of the country.

By 1930 the total number of Postal Savings depositors had changed little, but the geographic distribution of depositors had shifted considerably. A smaller proportion of the population in the seaboard states was using Postal Savings, while in the middle section of the country, the West North Central and South Atlantic States, Postal Savings had grown tremendously, relative to the number of inhabitants.

<sup>2</sup> In this paper the geographic divisions used by the Census are employed.

The rapid increase between 1930 and 1933 merely served to accentuate this tendency, so that by 1933 the eastern seaboard states had become among the least important users of Postal Savings facilities and Postal Savings had shifted to the West. Going from east to west, Postal Savings became of more importance in the community the further west one traveled.

TABLE II  
POSTAL SAVINGS DEPOSITORS CONTRASTED WITH TOTAL POPULATION  
June 30, 1920, 1930, and 1933

Geographic division	Postal savings depositors					
	Number			Number per 100 of population		
	1920	1930	1933	1920	1930	1933
New England	42,036	21,959	80,363	.57	.27	.98
Middle Atlantic	296,872	146,404	443,516	1.33	.56	1.69
East North Central	73,698	38,635	650,011	.34	.15	2.57
West North Central	20,467	70,224	357,282	.16	.53	2.69
South Atlantic	13,853	70,648	232,985	.10	.45	1.48
East South Central	6,925	7,890	63,227	.08	.08	.64
West South Central	7,098	27,680	132,574	.07	.23	1.09
Mountain	13,284	46,550	116,334	.40	1.26	3.14
Pacific	31,519	33,838	258,063	.57	.41	3.15
United States	505,752	463,828	2,334,355	.48	.38	1.90

The same general westward movement appeared in deposits, although the trend not quite so consistent, as appears from Table III.

TABLE III  
POSTAL SAVINGS DEPOSITS CONTRASTED WITH BANK SAVINGS DEPOSITS  
June 30, 1920, 1930, and 1933

Geographic division	Postal savings deposits					
	Amount (000 omitted)			Amount per \$100 of bank savings deposits		
	1920	1930	1933	1920	1930	1933
New England	\$11,079	\$ 8,028	\$ 53,091	\$ .42	\$ .17	\$ 1.27
Middle Atlantic	89,332	37,351	224,893	1.90	.34	2.43
East North Central	28,027	18,866	338,198	1.01	.40	18.99
West North Central	6,848	37,413	180,019	.38	2.23	22.71
South Atlantic	3,235	25,048	96,849	.31	1.70	11.37
East South Central	1,379	1,992	33,247	.43	.38	10.71
West South Central	1,653	13,091	66,861	.53	2.56	22.85
Mountain	4,690	18,391	56,761	1.35	5.16	28.74
Pacific	10,371	14,251	134,882	.83	.65	7.96
United States	\$156,614	\$174,431	\$1,184,801	\$1.03	\$ .64	\$6.11

Sources: Bank savings deposits—

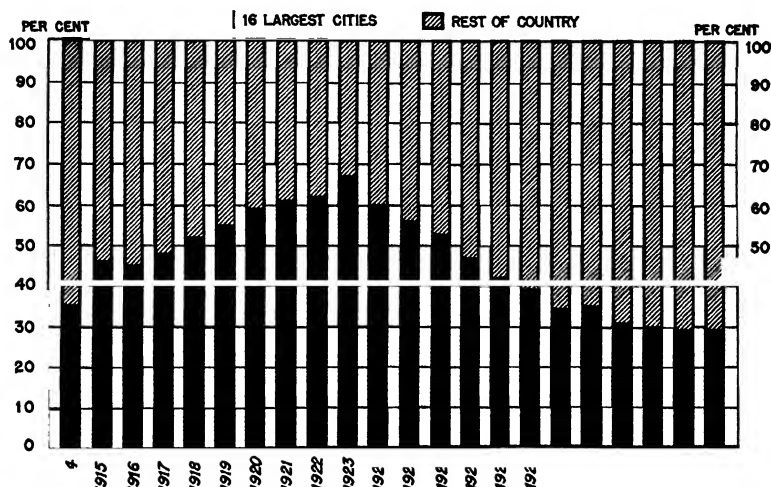
1920—*Savings Deposits and Depositors in Banks and Trust Companies of the United States for the Years 1918, 1920, 1925, 1930*; compiled and published by the American Bankers Association.

1930—*Annual Report of the Comptroller of the Currency, 1930*, pp. 56-7.

1933—*Annual Report of the Comptroller of the Currency, 1933*, pp. 99-100.

The declining importance of the industrial East is even clearer when the number of depositors and the volume of deposits in these sections in 1930 are compared with those in 1920. The New England and Middle Atlantic States had, in 1930, only 26 per cent of the deposits and 36 per cent of the depositors instead of the 64 per cent and 67 per cent, respectively, in 1920.

CHART II  
POSTAL SAVINGS DEPOSITORS IN THE 16 LARGEST\* CITIES  
COMPARED WITH THE WHOLE COUNTRY  
June 30, 1914-June 30, 1935



\* In 1930.

A further change in the distribution of Postal Savings during this period resulted from a shift in the relative importance of the large cities. In 1914 the proportion of all Postal Savings depositors reported by the 16 largest cities<sup>3</sup> was 35 per cent. This proportion increased to 67 per cent in 1923 and then declined steadily to 31 per cent in 1932 after which it remained almost constant at about 30 per cent. The trend for deposits corresponded closely.

The decline in the relative importance of the larger cities occurred in all parts of the country between 1920 and 1933 as is shown by Table IV. This trend was in spite of the general movement of population from the farms to the cities during this period.

<sup>3</sup> 16 largest cities in 1930: New York City, Chicago, Brooklyn, Philadelphia, Detroit, Los Angeles, Cleveland, St. Louis, Baltimore, Boston, Pittsburgh, San Francisco, Milwaukee, Buffalo, Washington and Minneapolis. These cities had an estimated total population in 1914 of 16,000,000 persons, about 1/6 of the population of the country.

TABLE IV  
PERCENTAGE DISTRIBUTION OF POSTAL SAVINGS DEPOSITORS, DEPOSITS  
AND POPULATION BY SIZE OF COMMUNITY\*  
1920 and 1933

Geographic division	1920				1933			
	Per cent in towns with population† of				Per cent in towns with population‡ of			
	Under 2,500	2,500 to 25,000	25,000 to 100,000	100,000 and over	Under 2,500	2,500 to 25,000	25,000 to 100,000	100,000 and over
<i>Depositors</i>								
New England	11	19	16	54	6	13	17	64
Middle Atlantic	4	7	4	85	6	12	9	73
East North Central	5	16	10	69	6	22	16	56
West North Central	7	18	9	66	22	39	12	27
South Atlantic	7	15	34	44	13	34	25	28
East South Central	22	20	6	52	13	36	11	40
West South Central	12	25	16	47	17	47	12	24
Mountain	25	34	26	15	26	48	16	10
Pacific	10	21	16	53	10	26	15	49
<i>Depositors</i>								
United States	6	12	9	73	11	27	15	47
<i>Deposits</i>								
United States	6	14	9	71	10	26	15	49
<i>Population</i>								
United States	49	15	10	26	44	16	10	30

\* Deposits and depositors are distributed by size of town in which Postal Savings depository is located. A Post Office may draw depositors from a larger community than the town in which it is located.

† Census of 1920.

‡ Census of 1930.

#### FACTORS IN THE CHANGES IN GEOGRAPHIC DISTRIBUTION

The principal reason for the concentration of depositors in the extreme East and West and in the larger cities in 1920 lies in the distribution at that time of the depositors by nationality. In 1915, 59 per cent of the depositors were foreign-born. They had \$49,000,000, or 72 per cent of all deposits. Hence, with the foreign-born using Postal Savings to the greatest extent, it followed that those parts of the country having the largest foreign population would supply the largest proportionate number of depositors. Likewise, the preponderance of Postal Savings in the larger cities is explained by the fact that out of a total of 14,000,000 foreign-born residents in 1920, 9,000,000 lived in cities of over a 100,000 population and only 3,000,000 were in rural sections. The popularity of Postal Savings among the foreign-born was not surprising in view of the fact that a prime reason for its establishment was to attract the deposits of immigrants.

There was little change in the geographic distribution of foreign-born population between 1920 and 1933. Therefore, the shift in the

relative importance of Postal Savings in the various geographic sections of the country reflected a change in the type of depositor. This is borne out by the fact that, in 1929, only 39 per cent of the depositors were foreign born as opposed to 59 per cent in 1915.

Consideration of the analysis described in this paper tends strongly to indicate that the rapid changes in Postal Savings deposits between 1930 and 1933 were but an intensification of fundamental, though hidden, changes in the type of depositors in the preceding decade. It is therefore to be expected that bank suspensions, which are generally believed to account for the remarkable growth of Postal Savings from 1930 to 1933, should be an important factor in the earlier transformation. This is especially true when it is remembered that the spectacular bank suspensions of 1930-1933 were the climax to a wave of bank failures which had been sweeping the country since 1920. From 1921 to 1929, 5,700 banks were closed, an average of 20 closed banks for every 100 banks active in 1920.

An examination of the rate of growth of Postal Savings deposits during the same decade, however, shows very little or no correlation with bank suspensions for the country as a whole if the abnormal increases of 1930 are excluded. During four of these years, when banks were suspending in considerable numbers, the deposits with the Postal Savings System actually declined and in the other years between 1921 and 1930, the growth was inconsequential. Not even allowance for the possibility of lag between the time that these banks failed and the time that their depositors resorted to Postal Savings can account for this lack of correlation as can be seen from Table V.

TABLE V  
NUMBER AND DEPOSITS OF SUSPENDED BANKS AND ANNUAL  
INCREASE IN POSTAL SAVINGS DEPOSITS  
1921-1930

Year	Suspensions		Annual increase in Postal Savings deposits (000,000 omitted)
	Number	Deposits (000,000 omitted)	
1921	505	\$172	\$ - 5*
1922	367	93	-15*
1923	646	150	- 6*
1924	775	210	1
1925	618	168	- 1*
1926	976	260	2
1927	669	199	13
1928	499	143	5
1929	659	231	2
1930	1,352	853	22

\* Decrease from previous year.

Source: Bank suspensions—*Annual Report of the Board of Governors of the Federal Reserve System, 1935*, p. 176.

The reason for this apparent lack of relationship lies in the distribution of bank suspensions. Suspensions were not only more numerous in the western part of the country but became severe there at an earlier date. In each of the early years of the decade at least two-thirds of the bank suspensions were concentrated in three geographic divisions alone, West North Central, West South Central, and Mountain States. Other states, particularly those in the East, were at first relatively unaffected by bank suspensions. In order, therefore, to compare the rise in the number of bank suspensions with the increase in Postal Savings, the various sections of the country must be analyzed separately.

TABLE VI  
RATE OF BANK SUSPENSIONS AND RATE OF INCREASE IN  
POSTAL SAVINGS DEPOSITS  
1921-1930

Geographic division	Number of bank suspensions, 1921-1930, per 100 active banks June 30, 1920	Deposits of suspended banks, 1921-1930, per \$100 of deposits in active banks June 30, 1920	Increase in Postal Savings deposits, 1921-1930, per \$100 on deposit June 30, 1930
New England	4	2	-28*
Middle Atlantic	4	2	-58*
East North Central	14	4	-33*
West North Central	34	17	446
South Atlantic	38	18	674
East South Central	19	17	44
West South Central	27	13	692
Mountain	36	17	292
Pacific	10	3	37
United States	24	7	11

\* Decrease in Postal Savings deposits from 1921 to 1930.

Such a comparison shows that where bank failures between 1921 and 1930 were relatively unimportant (New England, Middle Atlantic and East North Central States) Postal Savings steadily declined during those years. The relatively large proportion of Postal Savings held in these three geographic divisions was, however, so great as to conceal the changes in the opposite direction taking place in the rest of the country. It was in 1930-1933 when the widespread bank failures aroused general fear for the safety of the banks that even these sections, where Postal Savings had previously been unaffected by bank suspensions, began to register a marked growth in Postal Savings.

In Table VI the total changes between 1921 and 1930 are given. It will be noticed that the number and deposits of banks suspended have been related to the number and deposits of active banks at the beginning of the period so as to give the relative importance of the suspen-

sions in each section. The same adjustment has been made for the growth in the volume of Postal Savings deposits.

Similarly the growing importance of Postal Savings deposits in rural communities from 1920 to 1933 may be directly traced to bank suspensions. Out of a total of 11,000 bank suspensions from 1921-1932, three-fourths were in these small communities.<sup>4</sup> An examination of the population distribution in the United States shows that the geographic divisions which are predominantly rural were those sections which registered an increase in Postal Savings during the so-called dormant period 1920-1930, when the country as a whole showed no growth in Postal Savings. The sole exception is in the case of the Pacific States.

#### CONCLUSIONS

The Postal Savings System has passed through two distinct phases and is now about to start upon its third phase. Originally established for the purpose of attracting the savings of immigrants and of hoarders who did not trust American banking institutions, the Postal Savings System was useful in keeping money from being either sent abroad or secreted at home. This was borne out by the analysis of the depositors during the first decade of Postal Savings activity when it was found that the majority of the depositors were foreign born and were residents of the large industrial cities along the seaboards. The smallness of the average account seemed also to indicate that the poorer classes were using the Postal Savings depositories. Since the deposits received at the Post Office was money which otherwise would not have reached the banks, the Postal Savings System performed a valuable function and was supplemental and not competitive to the banks.

Shortly after 1920, a definite shift in the type of depositor began to appear and native-born Americans from the rural sections of the country were attracted to the System in ever growing numbers. This shift was found to be a direct result of the growth in the number of bank failures. Since the earlier bank failures were predominantly in the rural sections, the concomitant growth of Postal Savings was in these sections. At the same time Postal Savings deposits in the large cities declined so that on balance the total holdings of the System remained relatively stationary during the decade 1920-1930. It was not until 1930, when the large city banks began to fail in such large numbers as to engender fear for the safety of the whole banking system, that there was a country-wide correlation between bank suspensions and Postal Savings deposits. Nevertheless, the detailed analysis of

<sup>4</sup> *Annual Report of the Federal Reserve Board, 1934, p. 187.*



Postal Savings deposits has shown that the second phase of Postal Savings began as early as 1920 and, in the course of the thirteen years, 1920-1933, Postal Savings served as a haven for frightened bank depositors. During this period the Postal Savings System had changed from a supplement to the banking system to a direct competitor, although a competitor which was clearly filling a public need. Inasmuch, however, as the Postal Savings law was enacted as a substitute for the government guaranty of bank deposits, popularly demanded in 1911, this service rendered by the System during periods when the confidence in the banks was lost, may well be considered legitimate.

The reorganization of the banking system which occurred after the banking holiday of 1933, marks the beginning of the third phase of the Postal Savings System. The immigrants of the early days, for whom Postal Savings was primarily intended, have diminished in numbers and to a great extent have become acclimated to American institutions. The bank depositors who questioned the safety of the banks, and who therefore used the Postal Savings System during the second period of its life, have had their fears allayed by the establishment of the guaranty of bank deposits. At the present time the Postal Savings System appears to have no clear-cut function with regard to either of these groups. This is substantiated by the abrupt cessation in the growth of Postal Savings deposits upon the rehabilitation of the banks in 1933. Since that time Postal Savings deposits have increased relatively slowly.

From the point of view of the public the Postal Savings System today appears to render unique service in only two situations. Those communities having either no bank or no insured bank still have need of a guaranteed savings depository. On October 1, 1934, one-third of the towns and cities with Post Offices receiving Postal Savings did not have a single insured bank. Inhabitants of these communities are furnished through their local Post Office, a service comparable to that of the insured savings depositories in the banks of other communities.

For other depositors the Postal Saving System would no longer appear to be rendering any clear service. It would seem, therefore, that the Postal Savings System as now constituted has fulfilled its function. If its present trend continues, it will apparently compete with the banks over a considerable period of time without rendering any general compensatory service. Serious consideration should, therefore, be given at this time to determining what its function should be and accordingly what modifications should be made in the type of service it is to render.

## THE NEW SYSTEM OF POPULATION ACCOUNTING IN THE NETHERLANDS

BY DR. H. W. METHORST

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POPULATION registration, a valuable basis for good population statistics and consequently one of the important aids for the solution of the manifold population problems, increasingly commands the attention of all civilized countries. In most countries of the world two factors of population registration have had to suffice: (1) A census every 5 or 10 years. (2) Civil registers in which demographical facts are registered in chronological order. A third phase of population registration, and one of great importance, is a record by residence and family connection (rather than by month or year of occurrence) of data concerning birth, death and marriages, and migration.

This third factor of population registration, called "population registers," exists only in a few countries of the world. Population registers have been maintained in Belgium since 1847, in the Netherlands since 1850, in Italy since 1871, and in Denmark since 1924.<sup>1</sup> In Austria the Government introduced a similar registration in 1935, while in Turkey it is intended to introduce it in 1937.

Now two drawbacks are attached to the old registration system: First, when a family or a member of the family moves to another commune, the data concerning this family or concerning this member of the family, if he moves alone, are copied on a removal form and in the new commune the data are copied again from this removal form to the population register of the new commune. This gives rise to a great number of copying mistakes.

Second, under the old system, at a removal from one commune to another, only those data are transferred which represent the state of affairs at the moment of removal. Suppose a family consists of a father, mother and six children. If the mother and two children should die and later the father and children should leave the commune, it is only recorded on the removal form that a family removed, consisting of a father and four children. Consequently at every removal the demographic history of the family is broken off and begun anew from

<sup>1</sup> In Sweden and Finland there are Church-registers which are maintained by the clergy and which to a certain extent are analogous to our population registers.

the moment of settling in the new commune. To know the antecedents of the family, it is necessary to correspond about them with all the communes in which the family has lived from the beginning.

In the Netherlands by virtue of a Royal Decree a new system has been prescribed from July 1, 1936 on, which has already been introduced in more than 175 communes with more than one and a half million inhabitants in all, and which gradually will be adopted by all the communes. By this new system all the existing drawbacks are entirely obviated.

In the new system a card is drawn up for each child that is born. On this card is recorded the child's descent; and on it at an eventual marriage may also be recorded the name of the husband (or wife), the children born of the marriage and the children who have died. All the cards are uniform and consequently can be used for a new born child, as well as for a person 80 years old, who has been married three times and has had 12 children and a number of stepchildren. So on every card there is accommodation for the recording of the family connection, which is registered *only* on the card of the head of the family.

When one member of the family removes, the card of that person, the authentic card which was drawn up at his birth and on which in course of time his demographic history is recorded, is sent to the commune to which this person moves and inserted in the population register. In the commune of departure the data representing the state of affairs at the moment of departure, are transferred to a file card. At the removal of all the members of a family the same procedure is followed for all the cards pertaining to that family.

The new system is organized in such a way that for every person there may and can be only one card. At the removal to a foreign country, the cards relating to these persons are sent to a central office, the Inspectorate of the Population Registers. A person coming from abroad can only be enrolled after inquiries have been made as to whether a card relating to that person has been in existence. A link-register, which has a special function in the organization, enables the Inspection to see to it that there cannot possibly be two cards for one person. Inhabitants of caravans and of ships, and vagabonds, as far as they have no fixed residence, are also entered on individual cards. This special card index is maintained for the whole country by the Inspection of the Population Registers. When a person dies, his card is sent to the Central Bureau of Statistics. As the cause of death is also recorded on the card, the data thus obtained provide the basis for very valuable demographic researches.

Persons who stay in the Netherlands temporarily or those who, in

virtue of international law or usage, can claim the right of extraterritoriality are not entered in the population register. A temporary stay is considered to be a stay of not more than 30 days during the period of 90 successive days following the point of time of arrival in the Netherlands, if it concerns a Dutch subject; or a stay of not more than 180 days during the period of 360 successive days following the point of time of arrival in the Netherlands, if it concerns a foreigner. Temporary residents are not entered in the population register, but in a "temporary abode register"; they are not considered to belong to the population of the commune.

These are in brief the main principles of the new system. It implies all kinds of important consequences, which have been minutely regulated in a new Royal Decree. It came into operation in the Netherlands on July 1, 1936. Since 1930 the system has been successfully tried in a number of communes of divergent types.

In practice it has been proved that a card  $17 \times 23\frac{1}{2}$  cm ( $6\frac{1}{2} \times 9\frac{1}{4}$  inches) is sufficient to contain the most valuable data, which may be filled in by means of a typewriter of normal width, and that the card, which is not larger than the opening of a letter-box, may be of thin cardboard, provided it be made of excellent material, so-called "linen ledger," so that the cards may be preserved for hundreds of years.

The following important data are recorded on the individual card:

1. Christian names, and surname, day, month and year of birth, according to the birth certificate.
2. Name of commune of birth; if the commune of birth is outside the Netherlands, the name of the country.
3. Nationality.
4. Denomination or religious society.
5. Profession.
6. Christian names, day, month and year of birth and commune of birth of the father.
7. Surname, Christian names, day, month and year of birth and commune of birth of the mother.
8. Christian names, surname, day, month and year of birth, and commune of birth of the husband or wife.
9. Date on which and commune in which marriage was solemnized.
10. Date on which and commune in which marriage was dissolved, and cause of the dissolution of marriage (death, divorce, etc.).
11. Domicile and address. (At removal within the commune all the addresses are successively recorded with date of removal.)
12. The name of the new commune to which removed, recorded with the date of departure.
13. If the person comes from abroad, record is made of the last place of abode in the foreign country and the date of settling in the Netherlands.

14. Record of recognition, legitimation, denial of paternity, change of surname, or Christian names.
15. Data with regard to each of the children and stepchildren, recorded on the individual card of the head of the family: Christian names, surname, date of birth, commune of birth and whether the child is absent, married or has died; all this with mention of date. When the child has removed elsewhere or died elsewhere, the name of that commune is also recorded. At the marriage of a child it is recorded to whom he or she is married.
16. Head of the family on whose individual card this member of the family is recorded, on the card of each member of a family except the head.
17. Record of death: commune and date of death, number of death certificate and name of doctor who signed the certificate of death or who performed the post-mortem examination, and the cause of death.

The filling in of the data on the individual card is done by means of a typewriter.

A special space is left on the card for optional annotations (concerning suffrage, compulsory military service, passports, pauperism, vaccination, etc., etc.), or anything that might be considered (of value) desirable by the municipality. Some of these annotations may be made in pencil to be erased later.

Besides the above-mentioned annotations which are exclusively necessary for administrative purposes, scientific data may be recorded also, either on the card itself or on a supplementary card, concerning, for example, education received, examinations passed, special talent for art, science, politics, technical science, etc.; physical disabilities, idiocy, lunacy, abuse of alcoholic drink, hereditary diseases, feeding during the first year of life, etc., etc. To avoid misunderstanding it may be positively stated that the collecting of the last-mentioned scientific data is not prescribed. Attempts will be made to collect these data for each person individually by various means. These data may be conjoined with the obligatory data on the individual card thereby making possible important scientific researches, since the descent is recorded on each card.<sup>2</sup>

<sup>2</sup> See my paper, "Die Volksregistrierung und das neue in den Niederlanden eingeführte einheitliche System," in *Allgemeines Statistisches Archiv*, Band 26, p. 59-84.

## NOTES

### A TEST FOR THE GOODNESS OF FIT OF A CURVE GRADUATED TO A SERIES OF OBSERVED MEANS

BY JOSEPH BERKSON, M.D.

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A series of means of an observed variable  $y$  has been calculated, each mean corresponding to a definite value of a variable  $x$ , the latter being considered as determined precisely. For instance, the average calories per square meter ( $y$ ) of numerous individuals has been determined for successive years ( $x$ ) of life. A curve has been fitted representing  $\bar{y}=f(x)$  in which  $\bar{y}$  is the mean of  $y$  at  $x$ . We are not here concerned with the method that has been used for fitting the curve. We assume that methods considered to be the most appropriate for the situation in hand have been utilized. The fitting may have been accomplished by use of such a criterion as least squares, or the curve may have been drawn "by eye," guided by certain *a priori* conceptions of the relationship of  $y$  and  $x$ . Is the fit a "good" fit? Intuitively, we say that if the points representing the mean values of  $y$  are very distant from the curve, all along its route, the curve is not good, for it fails to follow the points observed. On the other hand, if the observed points are always on the curve, that is, if the curve has been drawn exactly through them, the curve is not satisfactory; the entire purpose of smoothing has been forfeited. In certain regions between these extremes the curve may be considered an acceptable fit. The test described below gives a criterion for judging whether, considering the curve as a whole, it has been placed excessively far from the points, and also whether it has been drawn to accord with them too closely.

Having fitted the curve, we consider that for the purposes in hand it represents the true positions of the means. We question whether the observed means vary about the curve, as they would about the true curve, taking due regard of random variation, or whether they are improbably discrepant. In order to answer this question we make the hypothesis that the fitted curve gives the true positions of the means, and test the deviations accordingly. If the observed means are distributed about the smoothed curve as random samples from a set of true values represented by the curve, the distribution of the ratios

of the deviations of the observed means from the curve, to the standard deviations of the respective means, should be normal, i.e., Gaussian. This will be very closely true even if the original distributions of  $y$  are not normal. We therefore obtain the difference  $D$  between each mean as determined from the observations of  $y$  at  $x$ , and the value of  $\bar{y}$  given by the curve at  $x$ . This is to be expressed in ratio to the standard deviation of the mean,  $\sigma_m$ , which will be given by  $\sigma/\sqrt{n}$ , where  $\sigma$  is the standard deviation of the values of  $y$  at  $x$ , and  $n$  the number of observations used in calculating the mean. For  $\sigma$  we use the best estimate available in the circumstances. If values of  $\sigma$  can be obtained from independent experiments, or from an independent estimate of the regression of  $\sigma$  on  $x$ , these values should be used.<sup>1</sup> But generally this will not be the case and  $\sigma$  is calculated by the usual formula  $\sqrt{\Sigma d^2/(n-1)}$ , in which  $d$  represents a deviation of  $y$  from the observed mean, and  $n$  the number of observations used in calculating the mean. While, theoretically, we should use the true value of  $\sigma$ , the calculations in any practical application will not be importantly affected by the use of the usual estimate of  $\sigma$ , if  $n$  is not small (15 or more). If  $n$  is small at particular values of  $x$ , it is desirable to group the individual observations corresponding to several consecutive values of  $x$  to estimate  $\sigma$ .

For the distribution of the ratios,  $D/\sigma_m$ , the expected value of the mean is zero, and the expected value of the standard deviation is unity. This provides a comprehensive test of the goodness of fit of the smoothed curve. If the observed means are poorly balanced above and below the smoothed curve, the mean of the ratios will differ significantly from zero, either positively or negatively. If the curve does not follow the means sufficiently closely, that is, if the means are scattered more widely about the curve than should be expected as a matter of chance, the standard deviation of the distribution will be significantly *greater* than unity. If the curve follows the means *too* closely, that is if the curve has not been smoothed sufficiently and has been drawn to follow the points very rigidly,<sup>2</sup> the standard deviation will be significantly *less* than unity. Thus each of these departures from a good fit can be tested specifically by obtaining the difference of the mean and standard deviation of the ratios  $D/\sigma_m$  and their expected values, and noting whether these differences are significant. As a criterion of a significant difference from expected values, the usual criterion of twice the standard deviation of the pertinent difference is used, or the

<sup>1</sup> See reference for example.

<sup>2</sup> If the curve is expressed algebraically, this describes the situation where too many constants have been employed in the function representing the curve.

ratio of the difference to its standard deviation may be translated to a probability by use of a table of the probability integral of the normal curve, and any desired limiting value of  $P$  may be used as a criterion for rejection. The standard deviation of the difference from the expected value of zero for the mean of the ratios is  $1/\sqrt{N}$ , where  $N$  is the number of points fitted; the standard deviation of the difference from the expected value of unity for the standard deviation of the ratios is  $1/\sqrt{2N}$ .

The special advantages of this test are: (1) its simplicity of application, (2) its applicability to curves fitted algebraically or otherwise, and (3) the fact that it furnishes a specific criterion for rejection of a curve when it fits too well. The last is exceptional. A perusal of the literature on tests of goodness of fit will divulge that the discussion of the criteria for rejection when the fit is disparate from observation is voluminous and meticulous. Discussion of the meaning to be attached to the situation in which an exceedingly close agreement is found, so close as to be suspicious, is difficult to find. At best one discovers statements as to what such a result does *not* mean, and advice as to what should be done in this instance is either not given or is ambiguous.

An application to the problem of fitting curves for physiologic standards is to be found in the following reference:

Boothby, W. M., Berkson, Joseph, and Dunn, H. L., "Studies of the Energy of Metabolism of Normal Individuals: A Standard for Basal Metabolism with a Nomogram for Clinical Application," *Amer. Jour. Physiol.*, 116, 468-484, (July 1) 1936.



# THE INDEX NUMBERS, A.M.<sub>I</sub> AND A.M.<sub>II</sub>\*

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The relationships of price index numbers computed with the four systems of value weighting,

- I.  $P_0Q_0$ , base year price  $\times$  base year quantity
- II.  $P_0Q_1$ , base year price  $\times$  given year quantity
- III.  $P_1Q_0$ , given year price  $\times$  base year quantity
- IV.  $P_1Q_1$ , given year price  $\times$  given year quantity,

have been discussed in various places.<sup>1</sup> Fixed relationships have been demonstrated for indexes with certain weights. Where no fixed relationships have been found, it has usually been suggested that correlation between prices and quantities will send an index calculated with one system of weights above another with a different set of weights. This note is written to clarify to some degree the relationship between the first and second weighting systems.

If the relative price and the relative quantity movements are negatively correlated, and at the same time there is not a great spread in the sums spent upon the various commodities in the base year (i.e., not a great spread in the  $P_0Q_0$ 's) then an index constructed by the use of the arithmetic mean with the first system of weights will exceed an index of the same type with the second system of weights. Under the same conditions, because of the relation between the arithmetic mean and aggregate types of indexes, the aggregate weighted with base year quantities will exceed the aggregate weighted with given year quantities. On the other hand, if the relative price and the relative quantity movements are positively correlated and at the same time the spread in the  $P_0Q_0$ 's is not large, then A.M.<sub>II</sub> (or Ag. IV) will exceed A.M.<sub>I</sub> (or Ag. I). A proof of the above relationships with more exact statements follows:

$$A.M._I - A.M._{II} = \frac{\Sigma(P_1/P_0)P_0Q_0}{\Sigma P_0Q_0} - \frac{\Sigma(P_1/P_0)P_0Q_1}{\Sigma P_0Q_1}$$

\* The writer wishes to acknowledge his indebtedness to Professor Francis D. Murnaghan of The Johns Hopkins University for the assistance which he has given in working out the relationships discussed in this article.

<sup>1</sup> Irving Fisher, *The Making of Index Numbers* (Boston, 1922), ch. v; W. V. Lovitt, "Index Number Bias," *This JOURNAL*, Vol. 23 (1928), pp. 10 ff.; Warren M. Persons, *The Construction of Index Numbers*, (Cambridge, 1928), pp. 10 ff.

which—letting  $x = P_1/P_0$ , and  $y = Q_1/Q_0$ —becomes

$$\Sigma P_0 Q_0 x / \Sigma P_0 Q_0 - \Sigma P_0 Q_0 xy / \Sigma P_0 Q_0 y .$$

Therefore the difference has the sign of

$$\{ \Sigma P_0 Q_0 x \} \{ \Sigma P_0 Q_0 y \} - \{ \Sigma P_0 Q_0 \} \{ \Sigma P_0 Q_0 xy \} .$$

Let  $a$  and  $b$  denote, respectively, the least and the greatest values of  $P_0 Q_0$ . Then A.M.<sub>I</sub>–A.M.<sub>II</sub> will be positive if  $a^2(\Sigma x)(\Sigma y) - nb^2 \Sigma xy$  is positive, i.e., letting  $\bar{x} = \Sigma x/n$  and  $\bar{y} = \Sigma y/n$ , if  $(a^2/b^2)\bar{x}\bar{y} - \Sigma xy/n$  is positive, or if  $\Sigma xy/n - (a^2/b^2)\bar{x}\bar{y}$  is negative. It is to be noted that the last expression tends to become negative as  $a/b$  approaches unity, which is when the dispersion in the  $P_0 Q_0$ 's is not large.

The expression which determines the Pearsonian coefficient of correlation is similar to that above as  $r$  has the sign of

$$\begin{aligned} \Sigma(x - \bar{x})(y - \bar{y}) &= \Sigma xy - n\bar{x}\bar{y} \\ &= \Sigma xy/n - \bar{x}\bar{y} . \end{aligned}$$

This quantity is smaller than  $\Sigma xy/n - (a^2/b^2)\bar{x}\bar{y}$ . Consequently, if the latter is negative, the correlation between the price and quantity relatives must be negative. Put differently, when the correlation between the price and quantity relatives is negative and the spread in the  $P_0 Q_0$ 's is not great (i.e., when it is so small as to leave  $\Sigma xy/n - (a^2/b^2)\bar{x}\bar{y}$  negative) it can be guaranteed that A.M.<sub>I</sub> will exceed A.M.<sub>II</sub>.

In a similar fashion it can be shown that when  $\Sigma xy/n - (b^2/a^2)\bar{x}\bar{y}$  is positive,  $r$  is positive and A.M.<sub>II</sub> > A.M.<sub>I</sub>.

Several simple illustrations may be added to the above.

Com- modity	Base Year		Given Year			
	Price	Quantity	Price	Price Relative	Quantity	Quantity Relative
A	3	2.5	6	200	2.5	100
B	4	2	2	50	6	300
				A.M. = 125		A.M. = 200

In this hypothetical case,  $r$  for the price and quantity relatives has the sign of  $\Sigma xy/n - \bar{x}\bar{y} = -.75$ ; while  $\Sigma xy/n - (a^2/b^2)\bar{x}\bar{y} = -.45$ . It can be guaranteed that A.M.<sub>I</sub> > A.M.<sub>II</sub>, which if worked out are respectively 123 and 86. It should be noted that the spread in the  $P_0 Q_0$ 's is small, for commodity A,  $P_0 Q_0 = 7.5$ ; for B, 8.

In the following illustration, also, A.M.<sub>I</sub> > A.M.<sub>II</sub>, but the spread between  $a$  and  $b$  is such that the relationship between the two indexes could not be guaranteed.

Com- modity	Base Year		Given Year			
	Price	Quantity	Price	Price Relative	Quantity	Quantity Relative
A	1	1	2	200	2	200
B	4	2	2	50	6	300
				A.M. = 125		A.M. = 250

In this example,  $r$  for the price and quantity relatives has the sign of  $\Sigma xy/n - \bar{x}\bar{y} = -.375$ ; but  $\Sigma xy/n - (a^2/b^2)\bar{x}\bar{y} = +2.70$ . The spread in the  $P_0Q_0$ 's is large here, for commodity A,  $P_0Q_0$  equals 1; for B, 8. A.M.<sub>I</sub>, however, exceeds A.M.<sub>II</sub>; the former is 67, the latter 62.

# THE ANALYSIS OF REGRESSION IN SUBSETS OF VARIABLES

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My paper, "A Simplified Method of Determining Multiple Regression Constants," which was published in a recent issue<sup>1</sup> of this JOURNAL, outlined a method of calculating all the usual measures of regression and correlation and their standard errors in a set of  $n$  variables. If that method is used to analyze a problem of  $n$  variables it is easy to derive measures of regression and correlation in any or all subsets of  $n-1$ ,  $n-2$ , etc., variables. This is very important since a study of relationships among the  $n$  variables will often indicate the desirability of dropping one or more variables and using as the most reliable measure of the influence of each independent variable on the dependent the regression in some subset.

The previous paper gave a method of deriving the reciprocal correlation matrix, each element of which is

$$(1) \quad P_{ij} = R_{ij}/R$$

where  $R_{ij}$  is the cofactor of  $r_{ij}$  in the zero-order correlation matrix and where  $R$  is the determinant value of that matrix. The necessary statistical measures of relationship in a set of  $n$  variables can be derived easily from the  $P_{ij}$  values. It is also possible to derive a somewhat similar  $P$  matrix in the subset leaving out the variable  $x_k$ . If we denote an element in such a matrix by  $P_{ij)k} (= R_{ij)k}/R$  these elements may be calculated from the  $P_{ij}$  values by the equation

$$(2) \quad P_{ij)k} = P_{ij}P_{kk} - P_{ik}P_{jk}.$$

For example, let us suppose the  $P_{ij}$  matrix has been calculated in a problem of eight variables. We wish to drop the variable  $x_5$  and derive the values of  $P_{ij)5}$ . Equation (2) shows that  $P_{11)5} = P_{11}P_{55} - P_{15}^2$ ; that  $P_{12)5} = P_{12}P_{55} - P_{15}P_{25}$ ; etc.

These  $P_{ij)k}$  values can be used in place of the corresponding  $P_{ij}$  in equations (5), (6), (7) and (8) of my previous paper to get the necessary statistical measures in the remaining set of variables after  $x_k$  has been eliminated.

The  $i$ 'th line of the  $P_{ij)k}$  matrix can be checked by

<sup>1</sup> Vol. 30 (1935), pp. 694-700.

$$(3) \quad \sum_j P_{ij} P_{jk} r_{ij} = P_{kk}.$$

Similarly the elements  $P_{ij} P_{kl} = R_{ij} P_{kl} (P_{kk}/R)$  in the set leaving out variables  $x_k$  and  $x_l$  can be derived by

$$(4) \quad P_{ij} P_{kl} = P_{ij} P_{lk} (P_{ll} P_{kk}) - P_{il} P_{jk} (P_{ll} P_{kk}).$$

The check on the  $i$ 'th line of the  $P_{ij} P_{kl}$  matrix is

$$(5) \quad \sum_j P_{ij} P_{jk} = P_{kk} P_{il}.$$

By an extension of the same process it is possible to drop one variable at a time until we have the necessary relationships in any subsets we wish to study. Whether it is necessary to drop only a few variables or to study all subsets of all orders the writer believes the method outlined above is simpler and requires less work than the method outlined by Frisch<sup>2</sup> and certainly requires much less work than would be required for separate solutions for each subset.

Equation (2) is derived from Sylvester's theorem concerning the minors formed from cofactors. According to that theorem

$$(6) \quad R_{ij} R_{kk} - R_{ik} R_{jk} = R R_{ij} P_{kk}.$$

Substituting in (6)  $R_{ij} = R P_{ij}$

$$R^2 (P_{ij} P_{kk} - P_{ik} P_{jk}) = R R_{ij} P_{kk}$$

or, dividing by  $R^2$

$$(7) \quad P_{ij} P_{kk} - P_{ik} P_{jk} = R_{ij} P_{kk} / R.$$

Equation (4) is obtained by a similar development. The same general process can be used to drop any number of variables one at a time and to derive for any subset the cofactors of  $r_{ij}$  multiplied by a constant which does not in any way affect their use in calculating measures of regression and correlation.

<sup>2</sup> Ragnar Frisch, *Statistical Confluence Analysis by Means of Complete Regression Systems*, Universitets Økonomiske Institutt, Oslo, Norway, 1934.

## A TREND LINE FOR GROWTH SERIES, FURTHER REMARKS

A year ago this JOURNAL<sup>1</sup> carried a brief presentation of "A Trend Line for Growth Series," being tried by the Research Section of the Federal Reserve Bank of New York.

$$y = bc^{1/(d+x)}$$

$$\log y = \log b + \log c/(d+x).$$

This line, or curve, combines the useful characteristics of rising at a constantly decreasing percentage rate, and approaching an asymptote instead of, at some stage, turning down. These general characteristics can be obtained in other curves, but not so easily and simply.

The constants,  $b$ ,  $c$ , and  $d$ , may be obtained by the successive solution of the following equations (setting the year of the first fitted point,  $X_1$ , equal to 0):

$$d = \frac{X_2 X_3 (\log y_3 - \log y_2)}{X_2 (\log y_3 - \log y_1) - X_3 (\log y_2 - \log y_1)}$$

$$\log b = \log y_3 + d(\log y_3 - \log y_1)/X_2$$

$$\log c = -d(\log b - \log y_1).$$

Those who have experimented with the curve may be interested in a method by which, given the three points to be fitted, the three constants may be calculated with even greater ease and speed than is otherwise possible.

There is a first saving in time by spacing the three fitted points equally (i.e., making  $X_2 - X_1 = X_3 - X_2$ ), and giving the value  $-1$  to  $X_1$ ,  $0$  to  $X_2$ , and  $+1$  to  $X_3$ . Thus taking 1890 (the first fitted point) =  $-1$ , 1910 =  $0$ , and 1930 =  $+1$ : 1891 will be  $-.95$ ; 1892,  $-.90$ ; 1893,  $-.85$ ; . . . ; 1911,  $.05$ ; . . . ; 1929,  $.95$ . There is a further saving in time by expressing the ordinates of the three fitted points,  $y_1$ ,  $y_2$ , and  $y_3$ , as ratios to the ordinate of the first fitted point. This conveniently makes the logarithm of the first ordinate equal to zero.

The constants of the equation for the curve can then be derived from the following equations:

$$d = \log y_3' / (2 \log y_2' - \log y_1')$$

$$\log b' = d \log y_1'$$

$$\log c = -(d-1) \log b'$$

$$\log b = \log b' + \log y_1$$

where  $\log y_1' = \log y_2 - \log y_1$  and  $\log y_3' = \log y_3 - \log y_1$ .

NORRIS O. JOHNSON

<sup>1</sup> Vol. 30 (1935), p. 717

## THE PURPOSE AND PROGRESS OF THE ATTORNEY GENERAL'S SURVEY OF RELEASE PROCEDURES

On January 7, 1936, Attorney General Homer S. Cummings announced a nation-wide survey of parole, probation and all other forms of release granted by courts and penal institutions to persons found guilty of crime. This survey constitutes an integral part of a program for adequate and effective crime control and prevention through widespread public education, a careful evaluation of the effectiveness of various release practices now in use, the development of standards for adequate equipment and personnel and the consolidation of the efforts of those interested in the prevention of crime throughout the country. Its inception is a response to the recently aroused public sentiment against parole.

In initiating this survey, the Attorney General wrote personally to the Governors and Attorneys General of all the states, describing in broad outline the objectives of the survey and requesting their cooperation. The replies from the Governors and the Attorneys General were most favorable—in fact, enthusiastic. The policies of the survey were drawn up by an executive committee consisting of Mr. Justin Miller, Chairman of the Attorney General's Advisory Committee on Crime and Administrative Director of the Survey of Release Procedures; Mr. Brien McMahon, Assistant Attorney General in charge of the Criminal Division of the Federal Department of Justice; and Mr. Sanford Bates, Director of the Federal Bureau of Prisons. The preliminary plans of the survey, especially of its technical phases, were submitted to members of the American Sociological, Statistical, and Prison Associations in New York City on December 29, 1935, for advice and criticism.

The survey has two aspects. One is qualitative in character, dealing with a first-hand study of the facilities available for courts, probation departments, penal and correctional institutions and parole departments. The other phase is statistical in nature, dealing with case history material of individual inmates, parolees and probationers.

The field work began in mid-January, 1936, after a period of intensive training of eleven regional directors and eleven regional field supervisors. The regional field supervisors also had an extensive training period of several months in abstracting information from Federal files in Washington prior to their assignment in the field. The regional directors were sent out to make the contacts in the states and to obtain first-hand information about court and institutional facilities in the disposition and treatment of persons found guilty of crime. The regional field supervisors were sent out to set up WPA work units in institutions and courts for the abstraction of official statistics on carefully prepared case history schedules. These forms are recorded and verified in the field and then sent to Washington where they are submitted to a rigid consistency check. All case history schedules which do not with-

stand this test are sent back to the field for necessary corrections and verifications. When the schedules have been satisfactorily completed, they are coded and the data transferred to punch cards for mechanical sorting and tabulation.

Subsequently the data are analyzed to determine:

- (a) the frequency of various types of releases by different courts, penal and correctional institutions and parole authorities;
- (b) the interrelation between the various personal, social and other characteristics of persons found guilty of crime in relation to the dispositions made of their cases;
- (c) in cases of persons placed on probation or parole or other forms of provisional release, the interrelation that may exist between various characteristics of these persons and the likelihood that they will complete their provisional release periods successfully;
- (d) the criteria used by various courts, penal and correctional institutions and parole authorities in the selection of persons for various forms of release;
- (e) whether the available case history data obtained by custodial institutions, probation and parole authorities can be systematized to aid judges, probation officers and pardon and parole boards in selecting persons for different forms of release; and
- (f) the extent to which the available case history material can be systematized for the use of probation and parole officers in the individualization of their methods of supervision for more effective results.

To insure the uniformity and comparability of data collected from various jurisdictions, each recorder and each verifier is supplied with detailed instructions which are uniform throughout the country. There are standard schedules and instructions prepared for the regional directors in their qualitative phase of the work, also with the object of securing uniformity of approach throughout the country. To date, the regional directors, besides making personal contacts in their respective areas, have completed an intensive survey of the statutes and laws of different states which concern the sentencing and releasing of persons found guilty of crime. Rapid progress is being made in filling out questionnaires which embody a comprehensive analysis of the facilities and practices of the courts of general criminal jurisdiction in various parts of the country. Questionnaires designed to provide a comprehensive inventory of the facilities, personnel, procedures and practices of various state penal and correctional institutions are also being filled out. Similar questionnaires have been prepared to provide a detailed inventory of the facilities for probation and parole in different jurisdictions. All of these are to be filled out by the regional directors. Up to the present time, 117 work units under the immediate supervision of the regional field supervisors have been set up in the District of Columbia and 46 of the states.

These units have completed to date about 120,000 schedules of Federal and state parolees or persons whose provisional release was granted and terminated by discharge or revocation between 1928 and 1935, inclusive.



About half of these schedules have been edited and coded and the data recorded on punch cards. This material is now being subjected to intensive analysis and some preliminary analyses have already been made of the Federal cases. In so far as the analysis has proceeded, results appear to be consistent with previous knowledge and the findings in no case appear unreasonable in the light of what was expected. Similar case histories are being recorded on appropriate schedules for unconditionally released cases. Fifteen thousand of these case histories have already been recorded and are now in Washington or will shortly be shipped there. In addition to this, about 3,000 schedules have been completed on probation cases throughout the United States. This phase of the study is just beginning and will be expanded to include about 100,000 cases.

In order to determine the degree of precision with which the case history data are being abstracted from prison files, three sets of Federal schedules of 500 each were re-recorded by two separate sets of recorders, independent of one another, and the results have been analyzed to determine the consistency with which information for the different case history items can be abstracted from the files. One of these sets is being re-recorded a third time by a new group as a further basis for determining consistency. Similar controls are being used in the field. To date some 7,000 schedules in all have been duplicated by the different units to check the consistency of the work in each unit.

The survey is financed by WPA funds and has provided employment to over 750 persons. Consistent with the policy of the WPA, 90 per cent of the employees are from local relief rolls. Effort is being made to extend the work to all the states and to as many courts as possible, as rapidly as the limitations of supervisory personnel permit, without jeopardizing the uniformity of the work and the high standard of precision which is being maintained in this study.

The progress of the survey has been made possible through the hearty cooperation of state authorities who have generously aided us by placing at our disposal their files, necessary equipment and even, in some instances, supervisory personnel so as to assure the success of this nation-wide undertaking.

BARKEV S. SANDERS

Washington, D. C.  
October 23, 1936

## TRAINING FIELD AGENTS IN THE BUREAU OF LABOR STATISTICS

For several years the Bureau of Labor Statistics has been conscious of the fact that one of its pressing problems was to build up a staff of field agents properly and intelligently equipped to handle the complex work of the Bureau in the field of wages, hours of labor, and working conditions. These surveys are now made every two or three years in the more important industries of the country. In the less important industries they are made at irregular intervals.

In each of these surveys information is collected concerning wages and hours, annual earnings, descriptions of technological processes and individual occupations, personnel policies, and working conditions. The wages and hours data are compiled from the pay-roll records of the firms covered. Information as to occupation, race, sex, rate of pay, total earnings and total hours worked during the selected pay-roll period, and number of hours worked for one continuous week within that pay-roll period is obtained for each individual worker. The data collected on annual earnings consist of total earnings for a calendar year, as well as the total pay-roll periods worked.

Descriptions of technological processes and individual occupations are obtained by interviews with foremen and other supervisors actually in charge of the work, and by observation of the various operations involved in the shop or factory. The data concerning personnel policies are usually obtained by means of interviews with personnel or industrial managers and other persons in charge of these activities. Considerable information is also obtained from the personnel records of employees as to age, length of service, citizenship, etc.

To collect this information the Bureau has developed a trained staff of field agents. These agents are usually selected from the clerical staff of the Division of Wages, Hours, and Working Conditions, where they have acquired considerable experience in coding, editing, and tabulating. This background is helpful in properly carrying on the work in the field.

In addition to a knowledge of the statistical procedure involved, a satisfactory agent must also have an accurate understanding of the problems peculiar to the different industries studied. To meet this need, Commissioner Lubin two years ago inaugurated the practice of giving the agents a short training course in Washington prior to each field assignment. These courses last from three days to two weeks, depending on the complexity and importance of the industry. They are conducted under the supervision of the chief of the Wages and Hours Division, assisted by the section chiefs and the field supervisors in charge of the various phases of the work connected with the surveys. Lectures are also given by experts from the respective industries. Occasionally the lectures are illustrated by moving pictures of actual opera-

tion in the various plants. At these training courses the problems of sampling are also discussed and the agents are given their field instructions.

During the past summer these specialized training courses were supplemented by a general course in labor and industrial economics and statistics. The course was organized in cooperation with American University at Washington and was conducted on a college basis, credit toward a degree being accorded if desired by those completing the course satisfactorily. The course lasted three weeks, from August 3 to 22, during which period the field agents devoted full time to their classes and studies. The morning was given to lectures and discussions. The first two hours were under the auspices of Dr. Philip Taft of the University of Wisconsin, one hour being devoted by him to the subject of labor and industrial problems and the other to personnel and industrial management. The third hour was conducted by J. Perlman, chief of the Bureau's Division of Wages, Hours, and Working Conditions, who presented a survey of labor statistics as related particularly to the field of wages and hours. The afternoons were devoted principally to reading assignments. Written reports were also required daily, as well as a semester paper covering a particular topic in the course. At the completion of the course a final examination was given.

It is hoped that in the future it will be possible for the Bureau to continue these training courses for its field agents.

JACOB PERLMAN

Washington, D. C.

### A COÖPERATIVE ARRANGEMENT FOR GENERAL RELIEF STATISTICS

The Social Security Board and the Works Progress Administration, each requiring comprehensive current statistics of general public relief for effective planning and administration of their programs, have entered into an arrangement which will utilize personnel and facilities of both organizations for the monthly compilation of these data. The Federal Emergency Relief Administration still requires regular statistical reporting on the part of a considerable number of state relief administrations having unexpended balances of Federal funds and is also a party to this arrangement.

A staff of professional and clerical personnel has been assigned to work under the joint auspices of the Division of Research, Statistics and Records of WPA and the Bureau of Research and Statistics, Social Security Board. This staff, under the immediate direction of Thomas B. Rhodes, formerly Assistant Director of the Division of Research, Statistics and Records, WPA, has responsibility for collection and analysis of the monthly relief statistics. Field work in connection with the current reporting is a joint responsibility of the Social Security Board and WPA, although it is expected that in most states field work will be performed by the statistical field representatives of the Board. This plan, it is hoped, will result in considerable economy in field work, as well as convenience to state departments adminis-

tering both general and categorical relief. The data will continue to be published in the FERA monthly bulletin, *Trend of Relief in Continental United States*. It is not anticipated that basic changes will be made in the scope of the data which have been reported for the purposes of the FERA.

To facilitate this joint program an Advisory Committee on Collection of General Relief Statistics has been appointed by the Social Security Board and WPA for the purpose of currently advising on problems relating to the collection, interpretation and publication of the statistics. The chairman is Ralph G. Hurlin of the Russell Sage Foundation. The other members are Paul Webbink of the Committee on Social Security, Social Science Research Council; Frederick F. Stephan, Secretary of the American Statistical Association; Ewan Clague, Associate Director, Bureau of Research and Statistics, Social Security Board; and Emerson Ross, Director, Division of Research, Statistics and Records, WPA. The first three are members of the Joint Committee on Relief Statistics of the American Public Welfare Association and the American Statistical Association. The last two serve as representatives of the two coöperating Federal agencies. Mr. Rhodes acts as secretary of the committee. A member of the staff of the Central Statistical Board participates in its activities, as does also Helen R. Jeter, Acting Chief, Division of Public Assistance Statistics, Social Security Board, and T. E. Whiting, Assistant Director, Division of Research, Statistics and Records, WPA.

A review of recent developments in relief statistics is to be published in a forthcoming issue of *The Survey*.

## PROGRESS OF WORK IN THE CENSUS BUREAU

### THE 1935 CENSUS OF BUSINESS

Preliminary United States Summaries covering Retail Distribution, Service Establishments, and Radio Broadcasting were released in October. Summary reports on Banking Institutions and Wholesale Trade were issued during November; and reports for Construction and Busses will be available early next year. The summary reports show, by kinds of business, the sales or receipts, active proprietors and firm members, employees, and pay rolls, for the United States and for each state.

Two studies conducted by the Bureau of the Census in connection with the census of business will be of special interest to JOURNAL readers. The first of these is an attempt to set up sampling areas which will be representative of retail trade. It has been proposed on several occasions that a national census of business be taken quinquennially and that comparable annual data be secured from a limited survey of retail and wholesale trade. The research now under way is being limited to retail trade. Attention is being given to different types of sampling techniques but most of the research at present is concerned with testing area samples. These tests will determine the feasibility of selecting a group of counties or cities, or both, from each state so as to provide a representative sample of retail sales, the economic and social factors affecting sales in each state, and in the different size classes

of cities in the country as a whole. Nearly 300 area samples have been tested with data on retail sales by the eleven-fold breakdown (Food Stores, Eating Places, etc.) of the reports for 1929 and 1933. A number of special tabulations of the 1935 census will be made for these area samples. It is hoped that area samples will provide sufficiently reliable data in measuring annual fluctuations to meet the needs for inter-census estimates comparable with the 1935 census of business, the 1933 census of American business, and the 1929 census of distribution.

The second special study pertains to individual cities. Business areas are being laid out in much the same manner as census tracts have been established for the census of population. The more important business areas of several large cities are being mapped and studied in preparation for their possible permanent use as statistical areas. This will provide the basis for studies such as the shift of certain types of business from one area to another, the growth of sub-centers, the relation between sales and population density or purchasing power, etc.

#### THE 1935 CENSUS OF AGRICULTURE

Volume II of the 1935 census of agriculture, containing statistics on farm population, the movement of population from cities to farms, farm labor, non-farm employment of operators, and the fruit, vegetable, legume and other items of farm produce not included in Volume I, will be available for distribution in January. This volume contains the second series State bulletins, previously issued, and a United States summary. A third volume entitled "Statistics by Subjects" is now in preparation. Though smaller than Volume IV of the 1930 census of agriculture, this report will be entirely comparable with it for all items covered in the 1935 census. These three volumes will complete the major reports of the 1935 census.

*Minor civil division tabulations.*—Nearly all items in Volumes I and II of the 1935 census of agriculture, except those with a cross tabulation by color and tenure, and by size of farm, have been tabulated by minor civil divisions. The publication of these data for the more than 50,000 townships and other minor civil divisions is impossible with present printing funds. However, the demand for such detailed statistics is very widespread and the Bureau of the Census, in cooperation with the Resettlement Administration and the Agricultural Adjustment Administration, is preparing transcription sheets for all states. These tables can be secured from the Bureau of the Census in the form of photostat copies of the state transcription sheets. The Bureau will be pleased to send all interested parties detailed information concerning minor civil division data.

C. L. D.

## CHAPTER ACTIVITIES

**THE CONNECTICUT CHAPTER.**—The Connecticut Chapter met in New Haven on October 22, 1936. The speaker at this meeting was Dr. Dorothy Swaine Thomas of the Institute of Human Relations at Yale, who has just returned from Sweden where she spent six months studying internal migration. The topic for discussion was "Continuous Population Registers in Holland, Sweden and Belgium." Dr. Thomas traced briefly the historical development of population registration and the technique of registration. She emphasized the utility of registers in producing data for the study of population movements.

**THE CLEVELAND CHAPTER.**—The first meeting of the 1936-1937 season for the Business Statistics Section of the Cleveland Chapter was held on September 28 at the Mid-Day Club. Fourteen members and guests were present. Mrs. Frida Selbert of the National Machine Tool Builders Association was chosen as Chairman for the ensuing year and Mr. J. T. Diebold of The Ohio Bell Telephone Company was reelected to the office of Secretary. After the selection of officers, the group made its semi-annual forecast of the index of industrial production of the Board of Governors of the Federal Reserve Board. The arithmetic mean of the individual forecasts for the 12 months ending with August, 1937, was 12 per cent above the actual average for the preceding 12 months. The percentage improvement estimated by the individual members ranged from 9 per cent to 16 per cent.

**THE PITTSBURGH CHAPTER.**—During the summer, meetings were held on July 23 and August 27 to plan the programs for the coming year and discuss other Chapter activities. On September 24 a meeting was held on the degree of recovery and probable future activity in three major lines of business activity. Mr. G. A. Doyle of the Bell Telephone Company of Pennsylvania discussed "Communication." Mr. David Tynberg of Kaufmann's Department Store discussed "Merchandising" and Mr. B. E. V. Luty of American Metal Market discussed "Steel."

**THE SAN FRANCISCO CHAPTER.**—In response to an inquiry from the District Secretary several members reported significant statistical studies in the San Francisco district. Mr. Fernando E. Harrison, Statistical Supervisor of the California State Employment Service, reported the release for the first time of detailed tabulations of the active file of the State Employment Service. This file is maintained under the perpetual inventory project in cooperation with the U. S. Employment Service. Dr. Emily H. Huntington, Chairman of the Heller Committee for Research in Social Economics, reported two studies of the standard of living of families in San Francisco and the East Bay. Mr. Charles P. Burgess, Statistician of Heller, Bruce & Company, reported a tabulation of financial statistics of the fifty largest cities in California showing direct and overlapping debt, government costs, tax collec-

tions and wealth indices. Similar data were tabulated for California counties. Mr. L. J. Schmoll, Assistant Secretary of the Metropolitan Life Insurance Company, reported that San Francisco had been divided into census tracts and the census tract system had been approved by the Geographer of the Bureau of the Census.

## STATISTICAL NEWS AND NOTES

**BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM.**—A study of the growth and distribution of large deposit accounts was published in the September *Federal Reserve Bulletin*. It was based on a survey of about 9,900 identical deposit accounts at 98 large member banks in 37 cities for October 25, 1933, and November 1, 1935. The survey was undertaken to ascertain the distribution of deposits among large and small depositors and among different economic groups and the significance of changes in the distribution.

The September *Bulletin* also contained a description of new statistical material relating to the volume of credit extended by brokers to their customers, together with related items, which now appears in a regular table in the *Bulletin*.

**FARM CREDIT ADMINISTRATION.**—The statements of condition of the Federal land banks, Federal Farm Mortgage Corporation and Federal intermediate credit banks published quarterly by the Farm Credit Administration through December, 1935, have been replaced in 1936 by a new publication entitled the *Farm Credit Quarterly*. In addition to financial statements of lending institutions the *Quarterly* includes articles on particular phases of the agricultural credit situation, especially as related to the functioning of the Federal farm credit system. The new publication also contains appendix tables covering loans and discounts of institutions under the supervision of the Farm Credit Administration, the outstanding securities of these institutions, and indexes of farm income by Farm Credit Administration districts.

**BUREAU OF AGRICULTURAL ECONOMICS.**—The Bureau of Agricultural Economics is engaged in testing wheat yield data collected in connection with the Agricultural Adjustment Administration to determine their adaptability for rate making in various proposed crop insurance plans. Costs of indemnifying wheat crop losses have been determined in 210 counties. Data on identical individual farms cover the 6-year period 1930 to 1935 inclusive.

In the field of farm-mortgage credit the Bureau of Agricultural Economics in cooperation with the Bureau of the Census sent out special schedules to more than 400,000 farm owners. Nearly a 40 per cent return has been received. The data are now being tabulated and it is anticipated that with these and other data available it will be possible to issue a preliminary farm-mortgage debt estimate by states for 1935 and 1936 shortly after the first of the year.

The Division of Farm Population and Rural Life began in August a

special survey of farm labor conditions in eleven counties scattered over the country and selected as representing certain types of farming. Mr. Josiah C. Folsom, assisted by Mr. Tom Vasey, supervised the work. Field work was started in August and completed in October. It is expected that tabulations will be finished in November. Data gathered concern farm laborers' working and living conditions, wage rates, perquisites, earnings, occupational experience, education, and participation in community life.

A series of studies have recently been undertaken for the purpose of improving the technique of gathering, analyzing, and publishing market news on agricultural products. Mr. S. R. Newell of the Division of Marketing Research is in general charge of these studies, but most of them will be made in cooperation with the various commodity divisions of the Bureau. Market reporting has from the beginning been one of the principal activities of the Bureau. The new research program is designed to test the reliability of market news, its adequacy for different uses and for different groups of people, and the effectiveness of the different types of reports and different methods of dissemination. The rapid changes in marketing methods which have occurred during the past decade, such as the growth in direct buying in many lines, appears to have made significant changes in the type of market news information which is needed and also has brought with it a number of new difficulties in getting reliable information.

One of the first of these studies to be undertaken is concerned with market reports on tobacco. Intensive work is now being done in this field and is being used in setting up a new marketing service covering tobacco auctions. In this problem, as in the case of most price reporting problems, one of the principal needs is to develop a method of sampling which will give a fairly accurate indication of the average price and of the range in prices on a particular day, and which will also give a reliable indication of the change in average price from day to day and from week to week. In the case of tobacco, the reliability of different sampling methods can be tested because complete records of all auction sales are available and they are classified according to grade and according to the type of buyer.

**THE FEDERAL TRADE COMMISSION.**—The Federal Trade Commission has largely completed its work on the study of agricultural income and related matters directed by the Wheeler Resolution (P. Res. 61, 74th Congress, First Session). This Resolution was extended into the field of table and juice grapes and fresh fruits and vegetables by Joint Resolution known as the Gearhart Resolution (P. Res. 61, 74th Congress, Second Session). The work of setting up this inquiry which calls for substantially the same information as was asked for under the terms of the Wheeler Resolution is now under way. The same is true of the inquiry into agricultural implements also directed by the last session of Congress (P. Res. 130, 74th Congress, Second Session).

The Commission released a few weeks ago another report on milk and milk products which contains some interesting statistical data for those



who are interested in the subject of milk. This report covers two or more milk distributing companies in each of the four cities of Boston, St. Louis, Cincinnati, and Baltimore. This report and one other which preceded it on the Philadelphia and Connecticut milk sheds are important, particularly for the reason that these reports present for the first time in any publication the actual gross profits of distributors separately for fluid milk, fluid cream, and other milk. The report on these four cities also contains detailed statistics on investment and profits of leading milk distributors in these markets. Other interesting statistical data in the report include information on butter-fat differentials, costs of operating country stations, and costs of handling various items sold from milk wagons on retail delivery routes. Still another interesting tabulation in the report is the distribution of the producers selling to one St. Louis distributor according to the number of quarts of milk delivered each day.

**BUREAU OF FOREIGN AND DOMESTIC COMMERCE.**—By the first of the year eight publications of major importance in both the domestic and foreign fields will have been released by the Bureau of Foreign and Domestic Commerce:

*Foreign Trade of the United States for the Calendar Year 1935.* A statistical and analytical summary of final figures on the total trade of the United States for 1935. Detailed statistics for 1935 and preceding years show total United States exports to and imports from the world, the geographic distribution of exports and imports, and the distribution of trade by economic classes and commodities.

*Foreign Commerce and Navigation of the United States, Calendar Year 1935.* An annual publication in which statistics of both exports and imports are shown in the 1935 edition. Data cover trade of the United States and its noncontiguous territories with foreign countries, trade in gold and silver, and intransit trade. The number, nationality and tonnage of vessels entered and cleared in foreign trade of the United States with each country during 1935 are also shown as well as customs districts, headquarters, and ports of entry.

*Statistical Abstract of the United States, 1936.* The fifty-eighth annual issue of this publication gives a summary of authoritative statistics showing the trends in trade and industry as well as social progress. It represents a digest of data collected by all statistical agencies of the National Government, as well as those of a considerable number of private agencies and several states.

*Sources of Current Trade Statistics.* This publication lists sources of pertinent current economic statistics released by both governmental and private agencies. This volume is designed to minimize the delay in finding sought-for data on production, shipments, employment, prices and orders by kinds of business and for products.

*Foreign Commerce Yearbook, 1936.* A compilation of economic statistics giving recent basic statistical information on commerce, industry and

finance, for more than sixty foreign countries with comparable data for a series of earlier years. The second part of the publication shows tables of comparative world statistics for a number of major subjects including tables of international trade accompanied by a review of that subject for 1935.

*Basic Industrial Markets of the United States.* This series of bulletins, which was begun with a study of the textile market last June, is designed to segregate by location (counties) and density (machinery in place and plant capacity to produce) the major industrial markets of the country. Additional reports which will be available by January include *Iron and Steel* and *Gas and Electric Utilities*.

*Insurance Transactions in the Balance of International Payments of the United States, 1919-1935*, released the last of August, is a study of the movement of funds into and out of the United States on account of the operations of foreign insurance companies in the United States and of United States insurance companies abroad. The text of the survey sets forth the annual movements of insurance funds, the influences affecting the flow, and the origin and destination of the funds by countries and geographic areas. Material is also presented in tabular form for a period of years.

*Regional Sales of General Merchandise in Small Towns and Rural Areas.* An article which appeared in the September issue of the *Survey of Current Business* in which was presented a new group of indexes together with a description of the method employed in their construction. The series represents rural retail sales of general merchandise in four main regions of the country, the East, the South, the Middle West and the Far West. Both the adjusted and unadjusted index figures are shown from January, 1929. Reprints of the article are available from the Bureau.

*Store Modernization Needs.* This study, released in August, is the result of a cooperative effort of the Federal Housing Administration and the Bureau of Foreign and Domestic Commerce. It presents, on the basis of a limited sample, an analysis of the actual physical condition and appearance of small and medium-sized retail stores and service establishments for 18 different kinds of business. Appropriate recommendations for improvement of such stores and certain observations pertinent to the findings are also presented.

*A Manual of Small Retail Stores* is in course of preparation. It will consist of about nine separately published booklets covering many phases of retailing of interest to the small operator. Several of the booklets are expected to be off the press before the end of the school year.

The series of trade association bulletins on some of the major industries of the United States, namely: *Construction*, *Foodstuffs*, and *Lumber and Allied Industries* will present sources of more detailed information, the names of those Government agencies most closely allied to the industry, and a list, with addresses, of national and interstate trade associations. Reprints of the *Construction* bulletin, which was the first of the series and

was released in April, are now available. *Foodstuffs Industries* and *Lumber and Allied Products* bulletins were released in November and December respectively.

The 1936 edition of *Selected Trade Associations of the United States* will be available shortly. This publication covers the nation's 2,600 trade associations of national and international scope.

BUREAU OF LABOR STATISTICS, U. S. DEPARTMENT OF LABOR.—Actual wage rates paid in the construction industry on public as well as private construction are being compiled and analyzed for 103 cities. For many years the Bureau has made annual surveys of union wage rates in the various building trades, but this is the first general survey of the wage structure existing in the building industry generally. The union wage survey for 1935 is now completed and the results will be published in the *Monthly Labor Review*, probably beginning with the December, 1936, issue.

The wage and hours survey of the shipbuilding industry that was being planned when the last issue of the JOURNAL was published is well under way. Coverage for Navy construction and repair will be 100 per cent and there will also be an adequate sampling for private yards. Out of this work it is expected that information will be made available on annual earnings as well as wages and hours, personnel policies, and occupational descriptions. Work on the bituminous coal industry study is still in the planning stage. It is proposed to use a 20 per cent sample chosen from the mines in all important producing states and from among deep and shallow workings.

Accident statistics for manufacturing and iron and steel workers in 1934 have been completed and published and it is anticipated that the 1935 returns for both groups will be completed about the end of the year. The Bureau is making plans to extend cooperation with the states, other Governmental agencies, and a number of universities for enlarging the scope of information made available in this field.

Field work on prison labor conditions has been completed in seven states, reports are available for three of these, and work is in progress in three additional states under the cooperative arrangement between the Prison Industries Reorganization Administration and the Bureau. This investigation of prison labor is more comprehensive than earlier work done in this field. Formerly statistics of the amount and value of goods made by prisoners were compiled. This is being continued but in addition the general social and economic problems connected with supplying work for prisoners under a state use plan are being inquired into.

A series of articles on union-management relations in particular industries and localities is appearing currently in the *Monthly Labor Review*. Studies of the glass industry, women's clothing manufacture in New York, and the hosiery industry have already been published and others will follow.

The 1936 edition of *Handbook of Labor Statistics* (Bulletin No. 616) is now available. This volume is the fourth of a series published by the Bureau in which labor matters during 1931-35 are reviewed and in which practically

all the work of the Bureau during those years is presented in abbreviated form.

The third edition of the *Handbook of American Trade-Unions* (Bulletin No. 618) which is now in press deals with the labor union situation as it existed in June, 1936. It covers the changes and developments in the labor movement that have occurred since the last edition of the handbook became available in 1929 and also gives the salient facts concerning the 156 national and international unions of the United States, including trade jurisdiction, government, methods of negotiating agreements and membership.

UNITED STATES EMPLOYMENT SERVICE.—*Survey of Registered Job-Seekers*: An analysis of the job-seekers registered with the public employment offices throughout the country at the close of 1935 compared with the similar registrations as of June 1, 1936, was recently completed by the Employment Service. This study is based upon an inventory system making use of detailed punched card records covering all active registrants with the Employment Service. Included in the analysis are data indicating the geographical distribution of registrants and information concerning the industrial background, occupational classification, age, sex, color, veteran and relief status.

A comprehensive report of the operations of the nation-wide system of employment offices during the two fiscal years ended June 30, 1936, was also recently prepared.

The Worker Analysis Unit and the Statistical Unit of the Occupational Research Program have completed work on a study of the potentialities required of workers in certain department store sales positions. A follow-up investigation has been undertaken, and additional data have been collected for a second study so that the validity of the criterion, the predictors, and the technical methodology used in the first investigation may be more fully determined.

The Editorial Group of the Occupational Research Program is working on an Occupational Dictionary. To date a preliminary draft of terms in the Construction Industry has been completed; this draft contains 1,800 occupational terms and titles which are in current use.

CHILDREN'S BUREAU, U. S. DEPARTMENT OF LABOR.—*Study of the Comparative Value of Certain Antirachitic Substances*. A study of the relative efficacy at different dosage levels, of cod-liver oil, viosterol, and several forms of vitamin D milk was completed recently in Detroit by the U. S. Children's Bureau, the Food and Drug Administration of the U. S. Department of Agriculture, and cooperating agencies and organizations in Detroit. This investigation was carried on during the winter months from 1933 to 1936. The antirachitics were administered at dosage levels ranging from 150 through 3,000 units to 567 infants, each of whom was observed from approximately one through six and one-half months of age. Diagnosis of rickets was based on X-ray plates of the bones of both forearms, taken at monthly intervals.

The results of this study demonstrate the necessity of considering such factors as color, sex, rate of growth in length, period of observation, and interval between examinations as basic when attempting to evaluate the efficacy of certain types of antirachitic substances in the prevention of rickets.

The evidence presented refers almost exclusively to the incidence of slight rickets as the dosage level was sufficiently high to prevent the development of moderate or marked rickets except in a few infants.

The incidence of rickets is significantly less among colored infants than among white for the different antirachitic agents, when all dosage levels were combined and, with few exceptions tends to be less, at different dosage levels.

When pertinent basic factors are taken into consideration, it becomes apparent that, despite their lower dosage level, the milks, especially those at 400 units, tend to be more effective in the prevention of rickets than cod-liver oil. There is also some evidence that viosterol is at least as effective as cod-liver oil. These results are not conclusive as the number of infants receiving any given number of units of a specific antirachitic is too small to give statistically significant findings.

There is no definite evidence from this study that one type of milk at the 400 unit level is superior to another in the prevention of rickets. Similarly, for the lower dosage levels no clear-cut conclusions with regard to comparative efficacy can be drawn.

The incidence of slight rickets has been shown to be closely and consistently related to growth in length when the dosage of the antirachitic is relatively high, whereas for infants in the lower dosage group there is no consistent difference in the incidence of rickets.

It would appear that if rickets is to be prevented or promptly controlled an amount of vitamin D must be given that will assure stability in the metabolic processes, providing for normal bone growth and allowing an adequate margin of safety for the rapidly growing infant. From the data here presented, this amount would appear at least as high as that contained in the usual dose of cod-liver oil; namely, two to three teaspoonfuls.

**WOMEN'S BUREAU, U. S. DEPARTMENT OF LABOR.**—A "Special Study of Wages Paid to Women and Minors in Ohio Industries Prior and Subsequent to the Ohio Minimum Wage Law for Women and Minors" has recently been released by the Women's Bureau as Bulletin 145. This study demonstrates the benefits that have accrued to women in Ohio through the application of the minimum wage law to the laundry and dry cleaning industries. In addition it traces women's growth in importance in the working population of the State, shows the variations in wages paid for the same work, compares wages and cost of living, explains why women's bargaining power is weak, and makes clear how even the better employers have been unable to remedy the situation.

Bulletin 146, entitled "A Policy Insuring Value to the Woman Buyer and a Livelihood to Apparel Makers," has just been released. This study outlines

the remarkable movement toward industrial stabilization in the coat and suit and the millinery industries and shows the important part the consumer may play in supporting high standards of working conditions.

"The Economic Problems of the Women of the Virgin Islands of the United States," Bulletin 142, will soon be available. This survey reviews the economic situation of women in the Islands and their meager opportunities for work, and suggests projects for the training and employment of women and the improvement of their living conditions.

Bulletin 144, a revision of No. 98, which brings up to July, 1936, the analysis of State labor laws for women, is in press.

Also in press is Bulletin 143, "Factors Affecting Wages in Power Laundries." The findings should prove of guidance value for employee, employer, and the public in their efforts to raise the industry to a high operating level. The study gives the amounts paid to employees during 1934, by sex and general occupation groups, in 22 cities in various geographic areas. Wage rates, hours, and fluctuation in employment are also discussed. Analysis is made of the relation between wage rates and prices charged for laundry services; the relation between laundry receipts and number employed and pay-roll expenditures, that is, dollar volume of business per operative and per productive pay-roll dollar; and the relation between productive labor costs and other costs. The report concludes that correction of fundamental defects in management in some laundries is necessary before all laundry employees will receive fair value for services rendered and the consuming public will pay only fair value for services received.

U. S. BUREAU OF MINES.—The Bureau of Mines is now engaged in a National Research Project involving an analysis of progress in mechanization and productivity for some of the major branches of mining. Work on the project is proceeding rapidly, and information of value to the mining industry is being obtained, although the results of the analysis will probably not be available for several months.

OFFICE OF EDUCATION.—Recent publications of the Office of Education of interest to statisticians are: Circular No. 162, "Federal Aid for Education," a brief history, data for 1934-35, and a bibliography. Circular No. 164, "The Average Cost Per Pupil for Plant Operation in Large City School Systems," for 1930, 1932, and 1934. Some data are also given for 1933 and 1935. Bulletin 1936, No. 3, "Junior Colleges."

The National Visual Instruction Survey has published through the American Council on Education a volume entitled *National Visual Educational Directory—A List by States of 8,806 School Systems, Including an Inventory of Audio-Visual Equipment*.

DIVISION OF RESEARCH, STATISTICS AND RECORDS, WORKS PROGRESS ADMINISTRATION.—*Works Program Statistics*. The employment series from the beginning of the Works Program has been revised to include all payrolls which have been issued for W.P.A. projects. The employment reports for

other Works Program agencies have also been revised to include all pay rolls, many of which had been received too late to be included in the original tabulations. The regular employment reports have been revised to show separately the hours and earnings of women employed under the program.

The number of reports has been extended for administrative and research purposes to include special tabulations on employment made necessary by the drought, special analyses of hourly earnings and former relief status for persons employed by type of project and by county, and special reports dealing with employment on projects supervised by the various operating divisions of the Works Progress Administration.

As of September 15, 1936, the Division has taken an inventory of the physical accomplishments on W.P.A. projects, and the data are now being tabulated. All principal types of construction and non-construction projects are listed, together with appropriate measures of accomplishment in terms of physical units.

During the past six months the Division has issued the following publications: *An Analysis of Employment on Works Progress Administration Projects in December 1935*, which deals in detail with the various groups of workers employed on the program, together with assigned monthly wage rates and actual earnings. A study conducted in March was summarized under the title, *Average Monthly Wage Rates and Actual Earnings, W.P.A. Security Wage Workers, March 1936*. Data from a similar June tabulation are now being put in final form for publication, while a September study is being edited and tabulated.

A publication entitled *Statistical Reports Covering the Works Program*, outlining in detail the regular series of reports prepared by the Division was issued during June. Studies are now in progress concerning the turnover of workers assigned to W.P.A. projects and the amount of shift in employment from one Federal operating agency to another. A study of the hourly rates paid and the number of assigned hours of work on projects, by states and by skills, is being prepared.

*Relief Statistics.* Monthly relief statistics have now been published for the first six months of 1936. The data cover the number of families, cases and single persons receiving general relief, amounts of relief extended to cases by sources of funds and total amounts of obligations incurred by sources of funds. Because of the curtailment of the emergency relief program and the rising importance of other types of relief, the scope of the general relief statistics published for 1936 is somewhat larger than that for the data published for the emergency relief programs of 1933, 1934, and 1935.

Prior to January, 1936, the relatively small amount of relief, other than categorical aid and institutional care, extended from local funds in accordance with the provisions of the poor laws was not included in the reports received by the Federal Emergency Relief Administration. Since the late fall of 1935, as balances of the Federal Emergency Relief Administration funds became depleted and the emergency relief program was curtailed, relief of the types not formerly included in the regular monthly reports

greatly increased in importance in many areas. Much of the relief was administered by local agencies and local officials that were not associated with the emergency relief program. In order to maintain a comprehensive series the present objective is to include in the general relief statistics beginning with January, 1936, all relief given in accordance with the provisions of the poor laws (exclusive of institutional care and categorical aid). As a result, the data relating to general relief for months beginning with January, 1936, have in many instances a somewhat broader scope than data for previous months relating to the general relief program which was conducted as a part of the emergency relief program.

The number of states reporting data which are believed to be reasonably complete has varied from 40 states in January to 32 states in June. The 40 states reporting in January represent slightly more than 83 per cent of the total population of the United States. For a few of these states the data reported do not include all general relief given locally in accordance with the poor laws. It is believed that the volume of this type of aid not included is relatively small for the group as a whole. Since the data reported for the remaining states are complete only for certain counties or are known to be incomplete, estimates for this group of states have been prepared in order to arrive at totals for the Continental United States. It is hoped that at a later date missing data will become available for at least a part of the states.

In order to facilitate the development of general relief statistics an interim arrangement has been made between the Social Security Board and the Works Progress Administration.\*

The following recent publications which contain statistics of general relief activities may be obtained from the Works Progress Administration: *Monthly Report of the Federal Emergency Relief Administration for March 1936*; *Monthly Report of the Federal Emergency Relief Administration for April 1936*; *Trend of Relief in the Continental United States from May to June 1936*; *Trend of Relief in the Continental United States from June to July 1936*; *Trend of Urban Relief from June to July 1936*; *Trend of Urban Relief from July to August 1936*.

*Distribution of Relief Funds Among the Political Subdivisions of the States.* This study, recently completed, examines the methods employed by states in determining the various cities' and counties' shares of available state and Federal funds. Attention is devoted both to the bases of distribution prescribed by state statutes as well as those evolved by state relief administrations. The methods employed in determining need for relief funds are treated separately from those determining the abilities of local units themselves to supply these requirements. This study will be published soon in the *Monthly Report of the Federal Emergency Relief Administration*.

*Relationship between Relief Programs and the Status of Labor.* The Division has inaugurated an investigation into the relation between the various relief programs and the status of labor in the country. During the summer months a group of economists studied the relief problem in its relationship

\* See p. 736.



to the status of labor in 33 communities in the United States. In connection with the conduct of this investigation, a study has been made of the methods of establishing prevailing rates which have been used by various agencies of the Federal government and under the various state laws. Data have also been gathered on rates of wages for the entire country. These data are being recorded on standard cards in order that they may be useful not only for the purposes of the investigation but for the use of any other agency. Several other Federal agencies, especially the Bureau of Labor Statistics and the Bureau of Agricultural Economics, have undertaken to cooperate with the Works Progress Administration in conducting statistical studies of actual rates of wages throughout the country.

**NATIONAL RESEARCH PROJECT, WORKS PROGRESS ADMINISTRATION.**—In the September notes of the JOURNAL, the activity of the Project was briefly outlined as it stood in July. As of October first considerable progress has been made and some new lines of study have been developed.

*Survey of Productivity in Selected Industries.* Field work in cooperation with the Bureau of Labor Statistics is under way in the following industries: boots and shoes, shoe machinery, leather, textiles, men's clothing, cotton garments, cigars and cigarettes.

Field work on studies conducted in cooperation with the National Bureau of Economic Research—in the brick and tile, lumber, cement, beet sugar, and flour milling industries—is, with the exception of flour, largely completed. The beet sugar study includes a survey of productivity of central office work. In addition, a study of the machinery and equipment industry has been undertaken with the objectives of, first, obtaining measures of labor needed to produce the machines used in the other industries studied, and, second, determining trends in the development of certain types of machines.

Field work covering a study of changing farm practices has been completed. Some 4,200 records were obtained from farms in 58 counties in dairy, corn, cotton, small grain, and fruit and vegetable producing districts. Secondary statistics on acres planted, production, labor requirements, technology, etc., are being compiled from data available in the U. S. Department of Agriculture. Similar cooperation is also being received from the agricultural schools of Cornell University, the University of Illinois, and the Giannini Foundation of the University of California.

The construction unit in the Division of Research, Statistics and Records of the Works Progress Administration is cooperating on a productivity study of the construction industry.

An historical study of technological developments in the railroad industry in relation to the changing volume of services and employment furnished is being conducted as a joint project with the Railroad Retirement Board. As noted below, this study also contemplates an extensive analysis of occupational histories of railroad employees.

In cooperation with the Bureau of Mines and under the supervision of

members of its staff, tabulations are being made covering changing productivity in the extractive industries.

*Surveys of the Effects of Industrial Changes on the Labor Market and on Individual Workers.* Surveys are being made to gather information on the relationship of employment and unemployment experience and occupational changes to selected industrial situations. The selection of the groups to be studied is governed by the need for illustrating various types of employment and unemployment situations which are related to changes in industrial techniques. Among the groups of workers chosen are included labor aggregations which in themselves constitute an entire community—both new industrial communities and “stranded” communities. Studies are under way in 14 localities ranging geographically from Massachusetts to Minnesota.

As part of the Railroad Retirement Board study mentioned above, a record of changes in the occupational and employment status of 400,000 employees of 14 railroads will be analyzed. This will be supplemented by a field study of the occupational histories of selected samples of workers who have been employed in the industry.

**DIVISION OF SOCIAL RESEARCH, WORKS PROGRESS ADMINISTRATION.**—In order to provide a running, month-to-month record of the types and amounts of public assistance extended to families in a number of sample counties in the drought areas, a *Survey of Public Assistance to Households in Drought Areas* has been initiated.

The information needed for the *Study of Public and Private Assistance in Rural and Town Areas* (reported in this JOURNAL, June, 1936) has been received regularly from the 36 states participating.

A survey has been made in cooperation with the Department of Labor in order to obtain information on the current transient and homeless problem for inclusion in a report to Congress on the movement of workers across state lines, as called for in Senate Resolution 298.

Among the *Research Bulletins* released during the past few months are included: Series I, No. 20—Inter-City Differences in the Cost of Living; Series I, No. 21—Quantity Budgets for Basic Maintenance and Emergency Standards of Living; Series I, No. 22—Source of Income of Former Urban Relief Cases; Series III, No. 1—Cases Receiving General Relief in Urban and Rural Areas, July 1933–December 1935 (Estimated); Series IV, No. 1—Survey of Cases Closed from State Emergency Relief Administration Rolls in 12 New Jersey Communities.

It is expected that the following final reports will be completed by the end of 1936: *Urban Workers on Relief in May 1934*. Findings of the Survey of Occupational Characteristics of Workers on Relief in 79 Cities, May 1934. *The Changing Aspects of Urban Relief*. Presentation of data collected in the Survey of Current Changes in the Urban Relief Population, 13 cities, 1935. *The Cost of Living in Urban Areas*. Based on Survey of Living Costs conducted in 59 cities in 1935. Cost of living of industrial, service, and other manual workers of small means at a maintenance and at an emergency

standard; relative costs in separate cities; causes of cost variation; detailed budget. *Migrant Families*. Residence history; transient relief history; personal characteristics; occupational characteristics; reasons for migrations; origin and destination. *Workers on Relief in the United States, March 1935*. A census monograph including statistics on the usual occupations, age, color, urban-rural place of residence, and sex, of over 6,000,000 workers on the relief rolls, including over 4,000,000 economic heads of relief families. *Landlord and Tenant on the Cotton Plantation*. Recent social and economic trends in cotton areas, management and organization of plantations. Landlord and tenant education, standards of living, incomes, and relief. *Part-Time Farming in the Southeast*. An analysis of southeastern industries and agriculture with relation to part-time farming and of a field study in five sub-areas of the Southeast (textile, steel, lumber and naval stores, and coastal plain). *Farmers on Relief and Rehabilitation*. Description of the trend of farm operator relief, transfers to rehabilitation program, character and amount of relief and rehabilitation grants. Shifts to and from agriculture and farm and family characteristics of clients. *The Rural Family in the Depression*. Family characteristics of relief cases. Special problems of women, youth, children and the aged. *Rehabilitation in the Drought Area*. Analysis of 13 sample counties in the drought stricken area with description of the extent to which government programs have alleviated conditions and the extent to which distress is relatively permanent.

**DIVISION OF PLACEMENT AND UNEMPLOYMENT INSURANCE, NEW YORK STATE DEPARTMENT OF LABOR.**—Since the publication of a descriptive note on the organization of the Division of Placement and Unemployment Insurance in the September issue of the JOURNAL, the Bureau of Research and Statistics of the Division has brought together a nucleus of its technical staff, by means of provisional appointments and by transfers from other departments of the State service in accordance with the State civil service regulations. It is expected that competitive examinations for these and other positions will be arranged after the constitutionality of the New York State Unemployment Insurance Law has been determined by the U. S. Supreme Court.

A program of occupational studies, the foundations of which were laid by the New York State Employment Service, has been brought under the direction of the Bureau of Research and Statistics. Field and analytical work under this program is being conducted in cooperation with WPA and the U. S. Employment Service. At the present time the supervisory personnel for this work is provided by the National Reemployment Service.

**HARVARD UNIVERSITY.**—At the Harvard Tercentenary Conference the very distinguished statistician, R. A. Fisher, gave a lecture on "Uncertain Inference." This essay will appear shortly in the *Proceedings* of the American Academy of Arts and Sciences in Boston. The degree of Sc.D. was conferred on Professor Fisher.

NATIONAL BUREAU OF ECONOMIC RESEARCH.—*Prices in Recession and Recovery, a Survey of Recent Changes*, by Frederick C. Mills, was published on November 30. It presents various materials gathered under Dr. Mills' supervision at the National Bureau the last several years. The chapter headings are as follows: (I) General Aspects of Recent Price Movements; (II) The Pre-Recession Situation; (III) Price Movements and Related Economic Changes during Recession and Depression; (IV) The World Price Structure in Recession and Recovery; (V) Price Changes and the Fortunes of Primary Producers in Recovery; (VI) Manufacturing Industries in Recovery; (VII) Capital Equipment and Construction in Recovery; (VIII) Consumers' Goods in Recovery; (IX) The Price System, Increasing Productivity and Recent Economic Changes.

Dr. Macaulay's *Some Theoretical Problems Suggested by the Movements of Interest Rates, Bond Yields and Stock Prices in the United States Since 1856* will be published by the end of the year. This book is the outcome of a long-continued study of interest rates. It has a large statistical appendix as well as many charts, six of which are inserts.

A report by Simon Kuznets on capital formation, giving the statistical results of his survey, is planned for early publication. A preliminary draft has been mimeographed.

For those interested in Dr. Mitchell's study of business cycles, mimeographed copies of the first three chapters of *Business Cycles*, Volume II, *Analysis of Cyclical Behavior*, have been prepared and are available on order. The first chapter states the aim that guides the investigation, the second describes the technique employed, the third presents statistical tests of the representativeness of the various measures secured by applying this technique. Number 61 of the National Bureau *Bulletin*, published on November 9, was entitled "Production During the American Business Cycle, 1927-1933," by Dr. Mitchell and Dr. Burns. Copies of both this *Bulletin* and *Bulletin* 57, which described the National Bureau's study of business cycles, are available.

Under the direction of Dr. Willits, newly-appointed Executive Director of the National Bureau, plans for the continuing program of cooperative research are being developed. In furtherance of this program, a series of conferences and discussion groups were held this autumn under the sponsorship of the National Bureau. A start upon this activity has been made in connection with the Conference on Price Research and the Conference on National Income and Wealth.

WHARTON SCHOOL OF FINANCE AND COMMERCE, UNIVERSITY OF PENNSYLVANIA.—The Industrial Research Department is undertaking a study for the Textile Foundation of the organization of production and distribution in the textile industries. This study is being made for the purpose of throwing light upon: (1) the factors which influence the nature and extent of vertical integration in the textile industries; and (2) the apparent effects of vertical integration in these industries.

In dealing with vertical integration, attention is being given not only to the direct linking of two or more stages of production or distribution through ownership, but also to various indirect methods such as the granting of exclusive agencies by sellers and the contracting for all or a substantial part of a producer's output by large buyers, frequently on a commission basis. Data for the study are being obtained for the most part through analyzing the experiences of selected companies which have in some way tried to link together two or more stages of production or distribution in the textile field. The companies selected include textile manufacturers, commission houses, converters, jobbers, garment manufacturers, wholesalers, and retailers.

The study is being made in cooperation with the Committee on Economic Research of the United States Institute for Economic Research and the presidents or managing directors of 12 textile trade associations. The following members of the Industrial Research Department are participating in the study: Anne Bezanson, C. Canby Balderston, George W. Taylor, Hiram S. Davis, Miriam Hussey, Robert D. Gray, G. Allan Dash, and Robert B. Armstrong.

The Industrial Research Department has recently completed a study on hourly earnings of employees in the hosiery industry. The National Association of Hosiery Manufacturers cooperated in the survey that was the basis for the report, the results of which have been published in a monograph entitled, "Recent Changes in Hourly Earnings of Employees in the Hosiery Industry," by George W. Taylor and Lillian P. Goodman.

Hourly earnings data were secured for each occupational group in the full-fashioned and seamless branches of the hosiery industry for selected weeks in 1929 prior to the depression, in 1933 at the depth of the depression, and in 1934 and 1935 when the industry was subject to the terms of an N.R.A. code. The 25 statistical tables in the report analyze the trends in hourly earnings by occupation and by principal producing areas.

The Industrial Research Department announces the completion of a second volume in its series of the history of prices in Philadelphia. This volume, and the supplementary one giving source material, deal with the significant fluctuations in wholesale prices from the close of the Revolution to the outbreak of the Civil War. Series for commodity groups representative of various producing areas of the economy are included in the interpretation. It is anticipated that the next study in this series, upon which work has just started, will make available data to extend the groups and individual commodities to the nineties in order to overlap modern price data.

"Migration and Economic Opportunity" is the title of the book by Dr. Carter Goodrich and his associates, of the Population Redistribution Study, affiliated with the Industrial Research Department of the University of Pennsylvania. The book has been published by the University Press.

Professor Hans Neisser of the Wharton School has completed his book on "International Factors in the Cycle of Prosperity and Depression."

NATIONAL INDUSTRIAL CONFERENCE BOARD.—The volume, *Private Long-Term Debt and Interest in the United States*, prepared by Leonard Kuvin,

issued September, 1936, contains a discussion of the growth and composition of such debt, and the interest charges on it. The period covered is from 1900 to 1925. The Appendix gives notes on the methods of estimating debt and interest.

The volume, *Wages, Hours, and Employment in the United States, 1914-1936*, prepared by M. Ada Beney, was issued September, 1936. It contains an exposition of the Conference Board's procedure in the measurement of wages, hours, and employment and the scope of its researches. The trend of wages is discussed briefly, but the body of the book consists of about 150 pages of tables in which all the results of the Board's monthly inquiry down to June, 1936, are presented in great wealth of detail.

Studies in the field of national income are being supplemented by a discussion of *Agricultural Income*, the work of Mr. Robert F. Martin, which is now in press. A study of *Unemployment and Relief with Special Reference to the United States* is being prepared by Mr. Vaso Trivanovitch.

In a recent reorganization of the Board's staff, Mr. Robert F. Martin was appointed Director of Research.

#### NEW MEMBERS

Balderston, Dr. C. Canby, Wharton School, University of Pennsylvania, Philadelphia, Pennsylvania

Best, Dr. Harry, University of Kentucky, Lexington, Kentucky

Casanova, Dr. Teobaldo, Assistant Professor of Psychology, University of Puerto Rico, Rio Piedras, Puerto Rico

Cohen, Dr. Bernard M., Statistician, Mental Hygiene Study, Johns Hopkins University School of Hygiene, 615 North Wolfe Street, Baltimore, Maryland

Dean, Joel P., Assistant Professor, Department of Economics, Indiana University, Bloomington, Indiana

DeVoss, Lewis E., Manager of Sacramento Office, California State Employment Service, 1714 K Street, Sacramento, California

Eisenhart, Churchill, Research Student, Department of Applied Statistics, University College, London, W. C. 1, England

Flick, Lawrence G., Manager, International Business Machines Corporation, 151 Broad Street, Providence, Rhode Island

Forster, Dr. Milton C., Special Assistant to the Chairman, Coordinating Committee of the Works Progress Administration and the Central Statistical Board, Washington Auditorium, Washington, D. C.

Hamilton, William R., Superintendent of System Operation, West Penn Power Company, 14 Wood Street, Pittsburgh, Pennsylvania

Holtzapple, John, Statistician, The Bell Telephone Company of Pennsylvania, 1835 Arch Street, Philadelphia, Pennsylvania

Hubbart, Dwight L., Head File Clerk, Central Statistical Board, 7816 New Commerce Building, Washington, D. C.

Johnson, Dr. Everett H., Instructor in Statistics, University of Detroit, McNichols Road Campus, Detroit, Michigan

Katz, Irving M., Reserve Audit Company, Guarantee Title Building, Cleveland, Ohio

Ketterman, Harry A., Statistician, U. S. Employment Service, Department of Labor, 204 Old Post Office Building, Portland, Oregon

- Knight, James**, Associate Professor, Educational Psychology, University of Texas, Extension Division, Box 972, Harlingen, Texas
- Kuznets, Solomon**, Statistician, U. S. Bureau of Labor Statistics, Department of Labor, Washington, D. C.
- Lemm, Frederick L.**, Assistant Secretary-Treasurer, Tom Huston Peanut Company, Columbus, Georgia
- Lewis, Janet H.**, Research Statistician, National Research Project of the Works Progress Administration, Room 414, 12 South 12th Street, Philadelphia, Pennsylvania
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- Marquard, Elva**, International Harvester Company, 606 South Michigan Avenue, Chicago, Illinois
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- Olson, Florence E.**, Teacher of Mathematics and Dean of Girls, Jerome High School, Box 901, Jerome, Arizona
- Shuttleworth, Dr. Frank K.**, Research Associate in the Institute of Human Relations and Assistant Professor of Education, Yale University, New Haven, Connecticut
- Silverman, Harry William**, Department Supervisor, United Merchants and Manufacturers Management Corporation, 1412 Broadway, New York City
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- Smith, Leonard**, Statistician, United States Rubber Products, Inc., 1790 Broadway, New York City
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- Smith, Willard C.**, Assistant Chief Statistician for Population, Census Bureau, Department of Commerce, Washington, D. C.
- Wareham, Ralph E.**, Assistant Actuary, General Electric Company, Room 600, Building 5, Schenectady, New York
- Warner, Zalie Valentine**, c/o Drysdale & Company, 71 Broadway, New York City
- Weichelt, John**, Operating Department, United States Gypsum Company, 300 West Adams Street, Chicago, Illinois
- Welck, Dr. Arthur A.**, Registrar and Professor of Education, Long Island University, 300 Pearl Street, Brooklyn, New York
- Zavoico, Basil B.**, Consulting Geologist, 2901 Gulf Building, Houston, Texas

## REVIEWS

*Examples in Finite Differences, Calculus, and Probability*, by Harry Freeman.

Cambridge: at the University Press. New York: The Macmillan Company, Published for the Institute of Actuaries. 1936. 86 pp. \$2.50.

How does one review a book of problems? Does one say merely, "This is a book of 400 problems, with their answers and 26 pages of notes?" Does one attempt to read it entire, as one would a treatise on psychology or logic, and set down the monumental thoughts which it evokes? Does one classify all the problems and give complete statistics on the accuracy of the answer book? Or, finally, does one write an essay on the impossibility of reviewing such a book?

Faced with this dilemma (or is it polylemma?), your reviewer has done no more than survey the book in a cursory way, in order to form a general impression as to the nature and merits of its contents, and make a spot check by solving a small number of problems which happened to catch his eye.

The impression produced by the general survey was a decidedly favorable one. Mr. Freeman's idea of providing a problem supplement for his "An Elementary Treatise on Actuarial Mathematics" is praiseworthy. The problems constitute a wide, well-balanced list with a liberal sprinkling of thought-provoking questions interspersed among others of a more routine drill type. The notes and hints are interesting and illuminating and frequently suggest unexpected methods of solution well calculated to broaden the repertoire of the thoughtful and resourceful student. The list of answers is complete. Indeed, at this point, your reviewer would have been inclined to recommend the book without qualification.

Such reservations as he may now have arose from the spot check. While it is necessary that they should be added to the record, it should also be pointed out that they do not entirely reverse the first favorable impression: for the sample is much too meager to be accepted as representative, and the only defect revealed was carelessness in small matters, which, though annoying, is not likely to be otherwise harmful.

Specifically, the spot check consisted of eleven problems. One of these (number 294) deals with a rather recondite matter and had best be left out of account, for, though the majority of experts would doubtless disagree with Mr. Freeman's comments on it, they would likewise disagree among themselves. Of the remaining ten, about which positive statements can be made, only six are unimpeachable as to statement, answer, and notes. The others are in error in various minor ways, as follows:

Problem 240 is misstated, as is obvious from the restatement in the note on page 66. Problem 297 has two sets of answers, of which one ( $p_1 = 0.436$ ,  $p_2 = 0.279$ ,  $p_3 = 0.205$ ) is not given. Problem 354 also has a second set of answers, which may be obtained by interchanging  $p$  and  $1-p$ . A strict interpretation of problem 392 leads to the answer zero. That given by Mr. Freeman is the mean *absolute* difference in length.



At this point the spot check was stopped, partly no doubt through laziness; partly also to avoid further irritation at the carelessness of an otherwise capable author. But the book is still a good one. Forewarned of its one defect, students and teachers in the broad field of statistics and probability should find it exceptionally helpful.

THORNTON C. FRY

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*Wahrscheinlichkeit, Statistik und Wahrheit*, by Richard von Mises. Vienna: Julius Springer. Second edition, 1936. viii, 282 pp. RM. 16.

This second edition of a book that appeared as a first edition in 1928 brings up to date the developments and discussion of a definition and theory of probability which Mises set forth in 1919, first in popular form under the title: "Marbes 'Gleichformigkeit in der Welt und die Wahrscheinlichkeitsrechnung,'" and then as "Grundlagen der Wahrscheinlichkeitsrechnung" in *Mathematische Zeitschrift*, Vol. 5 (1919), pp. 52-99.

Mises maintains (p. 21) that the phrase "probability that a designated man of specified age will die within a year" has no meaning in itself. There must be specified further the group of individuals in which the man is to be considered; and this, indeed, is arbitrary—the group might embrace all men and women of the given age in the world, or merely men in a given country with given occupation. Mises requires (p. 33) as preliminary to any definition of probability a fully specified assemblage, set, or collective (*Kollektiv*) of individuals or objects—conceivably infinite in number. A probability is then the limit—for  $n$  increasing indefinitely—of the ratio of the number of objects having a specified characteristic among the  $n$  objects under consideration. Two axioms must be satisfied: First, the limit just mentioned exists; second, the limit remains unaltered in any subset selected from the given set on the basis of *position* alone. For example, if 2, 5, 4, 6, 5, 3, 1, . . . are the throws of a die, and if in the limit the 5's appear  $\frac{1}{6}$  of the time in the given set; then also in the set obtained by selecting the alternate throws, 2, 4, 5, 1, . . . the 5's must appear  $\frac{1}{6}$  of the time.

Mises distinguishes his theory from: (1) the theory of Laplace and his followers who use "equally likely cases"; (2) the theory of Venn, Fechner, Bruns, and Helm, who use the first axiom without getting to the second; the theory of Copeland (p. 116), Reinhenbach, Popper, Tornier, Kamke, and Dörge, who in some way restrict the arbitrariness of the choice of the choice of the subset under Axiom II. Copeland, it should be noted, proved that there *exist* sequences of numbers satisfying both axioms provided the subset is to be selected from the given set  $a_1, a_2, a_3, \dots$  by taking the subscripts or *position numbers in any arithmetic progression*.

Mises takes up in a frank and delightful manner the objections that have been urged against his theory. Although defending his axioms, he does not consider (p. 114) that the last word has been spoken. He mentions (p. 119)

the psychological aspect of Axiom II. Now Mises is interested in *objective* probability—not *subjective* probability, such as is implied in Lourié's definition that probability is the science that *systematizes* our *ignorance*; and the *arbitrary position* selection, required by Mises in Axiom II, seems to possess a certain psychic or subjective aroma. Suppose a set of numbers, like the throws of a die, laid down or in the course of being run off. *Objectively* considered, there exist certain sequences of *position* numbers which if used would violate Axiom II. The point seems to be that no human *mind* can devise a rule for getting these numbers. In Copeland's modification of Axiom II, the subjective element disappears. But this limitation to arithmetic progressions is much more restrictive than desirable (p. 116). The Mises Axiom II implies that in a Monte Carlo game no system of play will improve the player's chance of winning. Mises regards the failure of all the many devised systems at Monte Carlo as empirical evidence of the substantial exactitude of his Axiom II (p. 30).

Of greater interest to many readers will be the chapters which connect this Mises theory of probability with modern developments in physics and mechanics. For example, the Heisenberg Principle of Indeterminacy is set forth (p. 259) in a most instructive manner; also, its relation to the collectives used to define probability. In fact, modern physics with its quantum theory and wave mechanics requires the theory of probability for its proper expression.

The bibliography gives the names of 140 authors, with more than one reference to most of them, and with more than 30 references to Jacob Bernoulli and to Poisson.

The book is marvelously devoid of mathematical technique, although it gives (Chapter II) in condensed form the main features of the Mises theory. The reader also finds easily understandable references to so many important problems of statistics and probability. To those especially interested in foundations and ultimate conceptions, the book will be of extremely great value.

EDWARD L. DODD

University of Texas

*Tables of the Higher Mathematical Functions*, Vol. II. Computed and compiled under the direction of Harold T. Davis, Indiana University and the Cowles Commission for Research in Economics. Bloomington, Indiana: The Principia Press. 1935. xiii, 391 pp.

The tabular material of the present volume is divided into three main divisions:

(1) The Trigamma function  $d^2/dx^2 \log \Gamma(x)$  and its first three derivatives (Tables 13 to 28). The total range covered is the same for all four functions, from  $-10$  to  $100$ ; the number of decimal places given varies from 10 to 17 according to the function and sub-range. Central differences are given for positive  $x$ .

(2) The Bernoulli and Euler Polynomials and Numbers (Tables 29 to 39). This section includes  $B_n(x)$  and  $E_n(x)$  for  $n=2, 3, 4, 5, 6, 7, 8$  and  $x$  ranging by hundredths from .01 to 1.00; the exact values of the first 90, logarithms and first 9 significant figures of the first 250, of the Bernoulli and Euler numbers; coefficients for Lubbock's Summation Formula; sum of the  $n$ th powers of the first  $p$  integers.

(3) Gram Polynomials (Tables 40 to 49). The fitting of a series of evenly spread data to a polynomial curve of the  $n$ th degree is effected directly from these tables as soon as the first  $n$  moments are obtained, for  $n=1, 2, 3, 4, 5, 6, 7$ .

A short account is given in each section of the formulae and methods used and of other existing tables, a very pleasing feature. Reasonable precautions appear to have been taken to insure accuracy. The last part of the closing sentence on page 331 is missing. There is a peculiar lack of uniformity as to the repetition of an entry, occurring at the bottom of a column, at the head of the next column. The printing is clear and the general arrangement pleasing. The present volume is a welcome addition to Volume 1 of the same series, and it is to be hoped that the next volume will appear in the not too distant future.

JOHN D. ELDER

University of Michigan

*British Association Mathematical Tables*. Vol. V. London: British Association for the Advancement of Science. *Factor Table*, prepared by J. Peters, A. Lodge, E. J. Ternouth, and E. Gifford.

This volume gives the complete factorization of every integer less than 100,000. There is also included at the end of the book a table of the reciprocals of the first 10,000 integers.

In such a factor table the all-important question is that of accuracy. The introduction sets one's mind at ease on this point. At every stage in the preparation extraordinary precautions have been taken to eliminate error. Three completely independent copies have been prepared, and proofs have been read six times, against all three copies. The statement found in the introduction that "... there is thus every reason to believe that no errors exist ..." seems well justified.

The arrangement and printing is, of course, exceptionally good, and the resulting volume fills admirably a long-felt need.

JOHN D. ELDER

University of Michigan

*Statistical Research Memoirs*, Volume 1, edited by J. Neyman and E. S. Pearson. Cambridge: Cambridge University Press. June, 1936. 161 pp. 15 s.

This is the first of a series of semi-periodical publications which will be issued annually from the Department of Statistics, University College, University of London. The *Statistical Research Memoirs* are being published

in continuation of a 30-year-old tradition established in 1904 by the appearance of the first *Drapers' Company Research Memoir*. The succession of publications which were issued throughout this period from the Galton Laboratory under the direction and editorship of Karl Pearson covered a wide range of subjects, including statistical theory, computing tables, and investigations in biometry, medicine, anthropology, and eugenics. The new series is to be devoted more specifically to the development of statistical theory and is to contain only papers prepared in the Department of Statistics at University College. The increased specialization of content in the new series is due, to some extent, to the reorganization of the Galton Laboratory into two distinct departments upon the retirement of the elder Pearson in 1933.

The present issue contains seven papers, all of which deal with certain special cases and further investigations in the theory of testing statistical hypotheses. Neyman and Pearson have approached the problem of testing statistical hypotheses from two points of view. The first method, which was based on the maximum likelihood idea was introduced in a paper published in *Biometrika*, XXA, 1928, pp. 175-240, 263-294. Here they distinguished between *simple* and *composite* hypotheses. More specifically, if  $H_0$  is a *simple* hypothesis the probability  $P\{A|H_0\}$  of a set of observed facts  $A$  is completely specified.  $H_0$  is tested in the light of a set of admissible hypotheses  $\Omega$  by means of the likelihood ratio

$$\lambda_0 = \frac{P\{A|H_0\}}{P\{A|\Omega \max\}},$$

Where  $P\{A|\Omega \max\}$  is the least upper bound of the probabilities of the same facts  $A$  for all possible simple hypotheses in  $\Omega$ . Similarly, a *composite* hypothesis  $H_c$  only partially specifies the probability of the facts  $A$  and asserts that the completely specified probability of the facts is a member of a set  $\omega$  of simple hypotheses;  $\omega$  being a subset of  $\Omega$ . The criterion for testing  $H_c$  is defined as

$$\lambda_c = \frac{P\{A|\omega \max\}}{P\{A|\Omega \max\}},$$

where  $P\{A|\omega \max\}$  has the same meaning for  $\omega$  as  $P\{A|\Omega \max\}$  has for  $\Omega$ . Increasing values of  $\lambda_0$  (or  $\lambda_c$ ) from 0 to 1 are regarded as corresponding to increasing strength of support of the hypothesis  $H_0$  (or  $H_c$ ) by the facts  $A$ . For a given amount of risk of error in rejecting  $H_0$  (or  $H_c$ ) when it is true a critical value of  $\lambda_0$  (or  $\lambda_c$ ) is found from the probability function of  $\lambda_0$  (or  $\lambda_c$ ) when the hypothesis  $H_0$  (or  $H_c$ ) is true.

In their newer approach to the problem of testing a simple hypothesis  $H_0$  Neyman and Pearson begin with the fundamental sample space  $W$  of the facts  $A$  and determine critical regions which have the property that for a given risk of error (of first kind) in rejecting  $H_0$  when it is true, the error (of second kind) is minimized in accepting  $H_0$  when it is false, that is, when an alternative hypothesis  $H'$  is true. The ideas have been extended to composite hypotheses and conditions have been obtained for the existence of *common best critical regions* with respect to a set of alternatives. In situations where no common best critical regions exist, the idea of *unbiased critical*

*regions* has been introduced and treated by the editors themselves in paper No. 1 of the present volume. Certain connections have been established between statistical functions characterized by R. A. Fisher as *sufficient statistics* and best critical regions, but it is shown in paper No. 6 that the existence of the one does not imply the existence of the other. Numerous papers have appeared in scattered journals by various authors on the theory and application of these two methods of approaching the problems of testing hypotheses.

Much of the practical statistical inference which is needed in experimental work can be reduced to a procedure of testing what Neyman and Pearson called *linear hypotheses*, which in turn depends on least squares and normal probability theory. The possibilities here have not been exhausted. For example, the technique of introducing dependent variables which take only the values 0 or 1 has scarcely been touched in the field of statistics. By this scheme the methods of Analysis of Variance and Covariance devised by R. A. Fisher, and many other problems involving both quantitative and qualitative variables can be reduced to least-square problems and their associated matrices of second-order products. These matrices provide an algebraic basis for defining such notions as degrees of freedom, interaction, orthogonality, etc. Paper No. 4, by P. O. Johnson and Neyman, deals with certain educational problems in which the analysis is reduced to problems in testing linear hypotheses.

Paper No. 5, by P. V. Sukhatme, consists of an application of the likelihood procedure for testing certain hypotheses about  $k$  samples from exponential populations. Paper No. 7, by R. W. B. Jackson, is concerned with the testing of hypotheses when the admissible hypotheses are characterized by a variable taking on discrete values; illustrated by a simple problem in genetics. The remaining two papers, one by P. P. N. Nayer and the other by B. L. Welsh, are shorter notes on the Neyman-Pearson  $L_1$  test.

There is a definite need, particularly for academic purposes, of systematically building the theory of statistical inference on a few clearly expressed principles; otherwise problems which can be handled methodically by commonplace methods will continue to appear to require fresh intuition for their solutions. The editors have virtually expressed their intentions of using the *Statistical Research Memoirs* in such a program. Those interested in some of the most recent developments in the theory of statistics will find this series most valuable.

S. S. WILKS

Princeton University

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*Studies of Differential Fertility in Sweden*, by Karl Arvid Edin and Edward P. Hutchinson. London: P. S. King & Son, Ltd. 1935. 116 pp. (May be purchased from the Population Association of America, 308 Victor Building, Washington, D.C.)

Students of population have awaited with much interest the appearance of this volume. It has been several years since Karl Arvid Edin first re-

ported a most unusual type of association between fertility and social status in Stockholm, Sweden. Unfortunately, the major results of his studies appeared only in Swedish. The brief and scattered reports in English aroused such interest that arrangements were made with the Social Science Research Council to have Edward P. Hutchinson of Harvard University collaborate in analyzing the data and in bringing out the present volume. The report consists of an introduction concerning Swedish official data and the measures of fertility available from them, a chapter relating to differential fertility in rural areas of Sweden, two consecutive chapters dealing with birth rates according to social-economic status in Stockholm, and a summary.

Full advantage seems to have been taken of the exceptional opportunities afforded by the demographic statistics of Sweden. Since 1750 the local parish registers have formed the bases of Swedish population statistics. These contain, among other items, individual records of birth, marriage, occupation, in-migration, out-migration, and death. Since 1860 abstracts from these registers, rather than direct enumeration, have been used for the Swedish decennial census. In their various analyses the authors used both the registration and census data. Some of the procedures entailed the identification or "matching" of families in the two sources. In one instance the data were restricted to families identified in both the 1920 and 1930 census reports. To insure accuracy of occupational returns and to make possible the division of families according to income and educational status of husbands, the family names were checked with lists of household registration for income taxes and with income tax returns.

Before considering the exceptional situation in Stockholm the authors present data to indicate that, in some respects at least, the fertility differences observed in rural sections of the Malar Counties of Sweden are consistent with those observed in other western countries. The measure of fertility used was based upon the number of registered confinements in 1930 and 1931 per thousand married women 15-44 years of age (as determined by the December 31, 1931 Census). The areas considered were divided into four "community groups" on the basis of "degree of ruralism" as determined by percentages engaged in agriculture. Each "community group" was divided into three broad occupational groups: agricultural laborers, others engaged in agriculture, and non-agricultural workers. The chief points of interest here were: (1) fertility declined with decreasing ruralism, (2) fertility was highest among agricultural workers and lowest among non-agricultural workers, and (3) occupational differences in confinement rates persisted within each type of community. Such findings are not unlike those observed in other western countries.

In Stockholm, however, a direct association between birth rates and social-economic status was found. The first set of data bearing on this situation pertained to live births during the four years 1919-1922 among unbroken Stockholm families in which wives were under forty years of age at the Census of December 31, 1920. The number of families meeting the above requirement was over 39,000, and these were classified according to occupa-

tional and income status of husbands. The four occupational groups included (a) workers in industry and unskilled day laborers (b) technicians, overseers, and office workers in industry, (c) trade and commerce pursuits, and (d) arts and professions. Each occupational group was subdivided according to income of husband in 1920 into the following classes: (1) Under 4,000 kronor, (2) 4,000-6,000, (3) 6,000-10,000, and (4) 10,000 and over.

The number of live births per thousand years of married life (standardized for age of wife and period of marriage) was computed for each of the above occupational-income groups. On the whole, the rates indicated a *direct*, rather than an *inverse*, association between fertility and social status. The fertility of industrial workers and day laborers was below that of the "upper" occupational groups, but the birth rates of the three "upper" groups were strikingly similar. There was, however, a consistent increase in birth rates with improved income status, and this situation persisted within each occupational class, except that of the workers and laborers.

On the hypothesis that the unusual situation in Stockholm might have been due to abnormal conditions in 1919-1922, intramarital fertility was investigated for a longer period, 1917-1930. The data employed related to all families in Stockholm meeting the following requirements: (a) marriage during 1917-1920, inclusive, (b) wife under 35 years of age at marriage, (c) husband and wife living together in 1920 and 1930, (d) family identified in the censuses of both years. Although the number of families meeting the above requirements was only 6,629, the data used permitted the analysis according to such factors as date and duration of marriage, ages of husbands and wives at marriage, income of husband in 1920, and education of husband as reported in 1930. With the above method the social class differentials in fertility were similar to those observed during the period 1919-1922. This was true for each of the dates and durations of marriage investigated. Further, within each income level, fertility rates increased from the lowest to the highest education groups. The persistence of this situation in crude as well as in standardized rates indicates that it is real and that it is not merely dependent upon standardization of ages or duration of marriage.

Throughout the report the authors have generally succeeded in acquainting the reader with the nature and limitations of the basic data, procedures and results. Many side-analyses were made which afford at least suggestive answers to questions concerning results. Perhaps practical considerations prevented a badly needed further exploration of the relation between occupation and fertility in Stockholm. We have seen that the direct association between fertility and social status was only partially manifested when occupation was used as the sole criterion of social status. The authors admit that the occupational classes lack specificity, but a further weakness is the meager and indefinite description afforded by the authors. The system used was apparently a hybrid occupational-industry classification. A sharper division of the white collar pursuits from manual labor and a clear-cut division of manual work on the basis of skill would have been more satisfactory.

The report is well organized, brief, and compact. Some readers may regret the absence of any discussion of local factors underlying this unusual situation in Stockholm. Such, however, was not within the province of this statistical investigation. Further data concerning social class differentials in birth rates will be available from the Swedish Census of 1935-1936. This census was motivated by the recently appointed Population Commission and, according to report, will include entries concerning economic status, occupation, and number of children born to unbroken unions.

CLYDE V. KISER

Milbank Memorial Fund  
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*The Growth of the Surface Area of the Human Body*, by Edith Boyd. Foreword by Richard Scammon. Minneapolis: The University of Minnesota Press. 1935. x, 145 pp. \$5.00.

Dr. Boyd has reviewed in her monograph all the literature on the measurement and estimation of the surface area of the human body and has tabulated the data on 1,114 subjects. Most of her calculations are based on 231 subjects for whom the data were reasonably complete. She has analyzed statistically the various methods of measurement and 36 formulae for the estimation of body surface.

The surface area of the body of human subjects and experimental animals has assumed greater prominence during the last two decades and at present is employed by many physiologists as a basis of reference for estimating basal metabolism, vital capacity, cardiac output, etc. Dr. Boyd is particularly interested in the anatomical relationship to growth and has included in her studies the prenatal as well as the postnatal period.

She believes that the principal methods of measuring surface area can, in the hands of competent workers, be repeatedly applied to the human body within a total range of error of less than 3 per cent but that integration tends to give values 4 per cent lower than coating or triangulation. She believes that estimations made by the linear methods give results within  $\pm 10$  per cent of the measured surface area. The analysis of the many formulae for estimating surface area from weight or height or weight and height together shows that those suggested in recent years are reasonably accurate. The old Meeh formula when  $S = K \times W^{2/3}$ , in which  $S$  equals the surface in square decimeters,  $K$  the constant 12.3, and  $W$  the weight in kilograms, gives results distinctly too high but with  $K$  between 10 and 11 this type of formula remains useful. Better results are obtained with exponents of  $W$  a little higher than  $2/3$ . The height-weight formula of the Russell Sage Institute of Pathology has been used a great deal since 1915, but Dr. Boyd shows that about a dozen other formulae give results slightly more accurate. Her statistical analysis indicates that the best formula from weight alone that will apply in prenatal and postnatal periods is the self-adjusting power equation  $S = 4.688 W^{0.8168-0.0154 \log W}$ . Somewhat better results are obtained by intro-



ducing the factor height,  $S = 3.207 W^{0.7288-0.0188 \log W} H^{0.3}$ . She finds the probable limits of normal variation for these  $\pm 16$  and  $\pm 14$  respectively. The formulae given by Boyd are complicated and their application is facilitated by the tables in her book.

This small monograph is carefully written, and it contains many valuable tables and figures. It will doubtless remain the standard work of reference for many years.

EUGENE F. DU BOIS

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*An Introduction to the Mathematics of Life Insurance*, by Walter O. Menge and James W. Glover. New York: The Macmillan Company. 1935. ix, 190 pp. \$2.60.

Strange as it may seem, this book appears to cover a really distinct field compared with that of any previous book in English. It covers the elements of actuarial science. Of course it makes no pretense of being a thorough treatment such as that given in *Life Contingencies*, by E. F. Spurgeon. On the other hand, it is much more comprehensive than the elementary books that have been written, not only such as those dealing principally with the subject of interest and annuities with some space devoted to life contingencies but also such as the old standard in America, the *Life Insurance Primer*, by Henry Moir.

The material is presented in a very interesting manner and is rather comprehensive in that it gives the elements of various phases of actuarial science that might not be expected, such as increasing insurance, select mortality tables, various methods of calculating reserve tables, and various alternative formulas which bring out the real meaning of different functions and their relationship. One is a little surprised to find even a chapter on gross premiums. If any criticism might be offered of the book it might be at the amount of space devoted to the subject of modified preliminary term valuation. On the other hand, this subject had never been comprehensively treated, and the authors' methods are new and illuminating and would have been very valuable even for actuaries if Mr. Menge had not subsequently further elaborated the subject in a paper "Preliminary Term Valuation Methods" in Volume XXV of *The Record* of the American Institute of Actuaries. A valuable feature is the unusually good sets of problems throughout the book. Sufficient actuarial tables are given to enable the student to solve the problems.

JAMES S. ELSTON

The Travelers Insurance Company

*A First Course in Educational Statistics*, by Edna E. Kramer. New York: John Wiley & Sons, Inc. 1935. ix, 212 pp. \$2.50.

In the preface of this book the author has stated the following as her objectives: "(1) to present in elementary fashion those statistical facts which

form a necessary background for a proper understanding of educational literature and a minimum prerequisite for educational research. . . . (2) to reduce the mathematics involved to simplest form. . . . (3) to stress the practical rather than the theoretic aspects of the subject." The objectives seem to be appropriate for a book having this title.

All the topics expected in a first course in educational statistics are found in the book. Beginning with elementary statistical procedures, which include directions for grouping data and the making of frequency tables, the treatment passes on to averages, measures of variability, graphs, frequency curves and the Normal Probability Curve, reliability of measures, and correlation. The last named is presented in two chapters. The development of the idea of correlation and of curve fitting is presented first. The next chapter is devoted primarily to applications of correlation. In an appendix is found a list of formulas appearing in the text and a derivation of several of them. This appears especially commendable.

Each topic is introduced by illustrations of its use. This serves not only for motivation but also to promote a more intelligent approach to the topic. The value of the book is enhanced also by closing each topic with a summary.

There are numerous exercises in the book. In some introductory texts in statistics the exercises are nearly exclusively computational in character. This book presents many whose primary purpose is to promote interpretation.

Each topic appears to have been developed with the learner constantly in mind. The step-by-step development is carefully done. The approximate mean, for example, is reached in five distinct steps and fills seven pages. In some topics diagrams are used to make clear what lies behind the computations. An example of this appears in the topic on the median.

Students taking this course vary greatly in mathematical ability and in the amount and recency of their mathematical training. This fact is recognized by the author when she presents detailed explanation and illustration of the use of tables of squares and square roots. Many students who have only a hazy notion of interpolation will gain a clear idea of it here. How to use the table of area under the normal curve is also treated in the same clear way.

The symbols and formulae used in the book are those which appear most frequently in educational literature. No typographical errors were noted.

Throughout the book the author appears to have kept her objectives in mind and to have attained those objectives to a marked degree. The result is an excellent textbook for a first course in educational statistics.

ROBERT V. YOUNG

University of Pittsburgh

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*Contribution a l'étude des fortunes privées d'après les déclarations de succession,*  
by E. S. Danysz. Paris: Berger-Levrault, 1935. 34 pp.

This study, leading to an estimate of the wealth—strictly, of the property in private hands—in France about 1931, is of chief interest to economic

statisticians for its development of method and its elaboration of certain significant facts about wealth distribution according to age and sex. The estimate itself yields, for all France, a figure of the order of 575 milliards of francs, of which somewhat over 100 milliards is assigned to inhabitants of Paris.

The practice of estimating total property of a living population from statistics of legacies is fairly old and may be said to reach to all times and places for which an inheritance tax or its equivalent creates such statistics. The crude process of estimating consists in multiplying the annual amount of property passed through inheritance by a factor representing roughly the average period between two passings of the same property. This factor is evidently, in a special sense, the average length of a generation.

Critics have long insisted upon certain defects in this process, chief of which is the implicit assumption that the property holdings of a group of individuals at death form a good sample of the property holdings of the entire living population. Such assumption is obviously unwarranted, mainly because the age distribution of decedents differs from that of the living whereas amount of property is correlated with age. Also, and especially in a country where custom or law acts in that direction, sex distorts the sample for this estimating scheme; and other characteristics of the population may play a minor part in damaging the validity of the sample automatically produced by death.

The essence of the Danyasz method—as he notes, it is the application of a method long ago suggested as appropriate whenever data in the necessary form should become available—is to treat each group of decedents, according to age and sex, as a sample of the living in that age and sex group. On this basis, the passage from the amount of property inherited in a given year to an estimate of total property of the living is a problem in weighted averages (or aggregates):

$$F = \sum \frac{V_{a.}}{D_{a.}} F_{a.}$$

where  $F$  is total estimated wealth,  $V_{a.}$  and  $D_{a.}$  are respectively number of living and number of decedents in a given age and sex group,  $F_{a.}$  is the aggregate wealth held by the decedents in such group, and summation covers all groups.<sup>1</sup> Here the sampling assumption manifestly consists in taking the average holdings of the living members of the particular age and sex group as equal to the average for the decedents ( $F_{a.}/D_{a.}$ ) in that group, a broadly tenable assumption.

By examination of the algebraic properties of  $C$ , the author finds that: (1)  $C$  varies inversely with average mortality of the entire population; (2)  $C$  is independent of differences, between times and places, in the general level of wealth; and (3)  $C$  depends upon the degree of correlation between

<sup>1</sup> I have not followed strictly the author's notation (his page 12), nor his algebraic formulation which is in terms of his coefficient  $C$ , the factor (mentioned above) representing average period between two passings of the same property.

amount of property and mortality at specific age (the same applies also to sex, apparently).

The bulk of the memoir reports the application of this weighted-average method to a limited body of data recently made available in France, in response to a resolution passed in 1909 by the Société de Statistique de Paris. Satisfactory examination of the memoir will be facilitated by a study of the earlier and related paper by the author, in which he discusses characteristics of the data in greater detail, presents tabular materials much more fully, and develops notable supplementary facts about the distribution of property.<sup>2</sup>

The present memoir contains, however, a helpful description of the data, with pertinent remarks about French customs and legal and administrative considerations; and there are significant comments on the trustworthiness of the data, with some reference to the question—ever-present in cases where statistics are generated by taxation—of evasion. A perplexing difficulty, which receives much attention, is the timing of the deaths, in relation to timing of corresponding tax reports. The data are not all-inclusive for France: they relate to Paris and to the one department, la Manche, which—on somewhat sketchy argument—is taken as a sample of France outside of Paris.

The main findings are emphatic: there is a definite correlation between size of fortune and age; the distribution is sharply different for men and for women, and for Paris and la Manche. Average fortune increases with age, throughout the range of age for Paris, and until middle life for la Manche. General average fortune, without regard to age, is higher for women than for men, both in Paris and in la Manche; but in the higher age groups, specific average fortune runs lower for women than for men.

With this evidence of association between size of fortune and age (and also sex) before us, there can be no doubt of the force of the author's main contention: that *C* is not a simple and constant factor but is a weighted index dependent upon economic, social, legal, and other demographic characteristics of a particular community at a particular time.

An American statistician may well inquire whether this method can be used in estimating total private property in the United States. Some significant evidence on the correlation of private fortune with age and other factors is afforded by portions of the record of Federal estate-tax statistics.<sup>3</sup> Unfortunately, the Federal tax has such a high exemption limit that these statistics do not enable us to carry out the Danysz analysis. If the Federal data were systematically tabulated (detailed breakdowns are no longer published) according to sex and age, much progress could be made in studying the property distribution for groups above those of very moderate means; but the mass of small holdings would be missed. This deficiency cor-

<sup>2</sup> "Contribution à l'étude des fortunes privées," *Bulletin de la Statistique Générale de la France*, XXIV, Oct.-Dec., 1934, pp. 111-171.

<sup>3</sup> I have discussed these data, and their limitations, in "The Distribution of Wealth," *Business Research Studies* 13, Boston, Harvard Business School, October, 1935.

responds to a similar gap in our data on individual incomes: American tax statistics cover directly only the incomes of the small fraction receiving somewhat more than day wages. Without discouraging the removal of the deficiency in the estate-tax data—perhaps by studying state and local records of small inheritances—and without denying the desirability of a more detailed tabulation of Federal estate-tax returns, we may fairly urge that the American economist prefers a more extensive and precise measurement of small incomes. All this is said in the light of practical needs of the American case—the method, analysis, and findings of Mr. Danysz are heartily commended.

W. L. CRUM

Harvard University

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*The Distribution of Wealth: A Factual Survey Based upon Federal Estate-Tax Returns*, by William Leonard Crum. Boston: Bureau of Business Research, Graduate School of Business Administration, Harvard University. Business Research Studies No. 13. Vol. XXII, No. 7. 1935. iii, 24 pp. 50 cents.

Professor Crum's latest contribution to the analysis of governmental financial materials constitutes a careful study of estate-tax statistics. The data, available from 1916 on, are subjected to scrutiny by plotting curves of the Pareto type. With the cumulative number of net taxable estates as ordinates and their size as abscissae, the resultant curve is quite smooth but possesses "an unmistakable curvature with upward convexity." If, however, the size of estate is adjusted to include the specific \$100,000 taxable exemption, then the curve becomes much more nearly straight (both scales, of course, are logarithmic). When a straight line is put through two points of this second curve, the reciprocal of its slope (for the year 1930, 0.806) furnishes a measure of "average inequality." Measured over time, average inequality shows something of a cyclical movement since 1922, culminating in a sharp decline in 1932-33.

Further analyses discuss size variations of estates in relation to the age of the deceased persons, their sex, and the composition of the estates' holdings of various types of investments during the 1922-33 period.

The significance of many of the findings is limited by the fact that the sample is severely truncated, i.e., it necessarily includes only estates of as much as \$100,000 (in some years, \$50,000). Professor Crum is careful, however, to point out this and other limitations; and, as in his previous efforts, he has utilized the available data to their fullest legitimate extent. The study is thus a fine start in the field of estate analysis. If it could ever be followed by sample analyses of surrogate court records for smaller estates, and the two sets of materials then linked to show facts concerning the degree of concentration of wealth, we might learn much of interest to both advocates and critics of the various "Share-the-Wealth" philosophies.

RALPH C. EPSTEIN

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*Stabilized Accounting*, by Henry W. Sweeney. New York and London: Harper & Brothers. 1936. xiii, 219 pp. \$3.00.

This book comprises two main things, a discussion of the problem of fluctuating values arising from changing price levels, and an accounting device by which correction may be made for these fluctuations. The former is likely to attract more attention, and to have much more far-reaching effects, than the particular method proposed for dealing with it. A number of examples are given to explain how the stabilized amounts will be computed and applied.

The central question provoked by this book is, of course, whether any such procedure will really add to the value of what the author terms "ordinary accounting" or "orthodox accounting." His first chapter, entitled "Where Ordinary Accounting Always Goes Wrong," strikes the keynote of the book and seeks to prepare the mind for his remedy. The difficulties he there points out are very real, and every man of experience in this field has been troubled by them. In casting about for ways in which to deal with this problem of changing values, accountants are likely to receive considerable stimulus and suggestion from this book, though they may not make much use of the author's specific recommendations.

The discussions throughout imply certain fundamental differences in viewpoint between the author and the "orthodox" accountants, and it is in these differences of viewpoint that the nub of the question lies. The first is that which leads him to adopt a predominantly mathematical conception of accounts. He complains (p. 42) that the balance sheet "violates the fundamental mathematical rule that like must be added to like." His plans require (p. 176) that "the total amount of theoretically correct depreciation that should have been provided on the books must be calculated." He aims at a "basis whereby final accomplishment is judged" rather than merely looking at "current accomplishment." This attitude is another example of the tendency which has been described as looking for certainty where no certainty exists, and there is the real difficulty with the entire program of stabilization. After all Mr. Sweeney's corrections, a balance sheet and income statement would still contain many variables subject to sound judgment; and the very insistence upon mathematical exactitude would tend to divert attention from these essential questions of judgment and thus mislead in the interpretation. For although accounting is quantitative in its expression, its interpretation must become essentially qualitative before it can be said to have reached a very penetrating level.

The plant account may be taken as an example. The author's method would result in showing the plant in the balance sheet at a replacement cost, that is, assuming it were stabilized at *current* price levels, a question which Mr. Sweeney leaves somewhat open. But is replacement cost nearer to a true value than the orthodox original cost? The true value of the property is really conditioned by the ability of the management which operates it. If the earning power is high, its true value may equal the replacement cost, or even exceed it; if the company goes bankrupt, the true value will

be in the neighborhood of junk prices. The author speaks of economic considerations; in the case of plant value, earnings and the ability of management which they reflect are the determining economic considerations.

It would be interesting to have Mr. Sweeney deal somewhat more definitely with the question of the price level at which he recommends stabilization, perhaps different levels for different purposes. On pages 109-110, he computes the inventories of a woolen mill, stabilized first on a base-year, and second on current price levels. In the subsequent balance sheet he chooses the latter; his stabilized inventories are then higher than the unstabilized, because prices have increased during the year—a result which is in conflict with the rule of the lower of cost or market. Elsewhere (p. 109) he takes cognizance of this rule and makes the base-year the point of stabilization. This particular piece of stabilizing approaches, in method and substance, the normal inventory method practised by a number of companies, and for which there is a good deal to be said.

The property accounts and the inventories are the accounts in which price fluctuations create most difficulty, and probably the difficulties are not removed by stabilization. When the author regrets that the ordinary balance sheet adds together "cabbages, carrots, and little red radishes" (p. 8), his distress is well founded; but after he gets through with his stabilization the cabbages, carrots, and little red radishes are still there, with a few pumpkins thrown in. Plant assets, inventories, and receivables really are very divergent assets; the art of accounting interpretation requires an understanding of these divergencies, and mathematical contrivances to eliminate them do not assist.

A number of corporations give, in their annual reports, information about price levels and unit prices relating to their inventories; less often they give information about present replacement values of their plant. In many cases it would be helpful if more information of this sort might be given, especially with respect to inventories; and, if this turned out to be one of the results of Mr. Sweeney's book, it will have eminently justified its appearance. But for purposes of the accounts original cost is probably still the most significant fact about the plant.

T. H. SANDERS

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*Twenty-Five Years of Accounting Responsibility, 1911-1936*, by George Oliver May. Essays and Discussions, edited by Bishop Carleton Hunt. New York: American Institute Publishing Company, Inc. 1936. Two volumes with independent paging, totaling 778 pp., under one cover. \$3.00.

A professional man has a number of responsibilities which do not attach to a business man—at least not in the same degree nor to the same extent.

The primary responsibility of each is that of succeeding in his chosen fields of work. Beyond that, however, the professional man has some obligations to his profession. He must so act in his own practice that the standards of professional practice are maintained and extended; he must not by his own practice bring his profession into disrepute. Further than that, he must be willing to take part in those activities which will bring among all practitioners an acceptance of the ethical standards of the profession and he must be willing to ally himself with others of his profession for the purpose of strengthening it and of extending its useful service to business and society. This responsibility is usually met by membership in professional societies, by service on their technical committees, and by acts of general service to his community, state, and nation.

The members of a profession must recognize also the duty of contribution to the substantial literature of the profession. Without this, much of professional experience arising out of the problems of practice would be lost to posterity. I do not mean to say that all contributions to the current literature of the profession are of substantial value, nor do I imply that the record of the solution of the current problems of practice will, *ipso facto*, provide the solution of the problems of future practice; problems of practice are never met twice in exactly the same setting. In a profession—as distinguished from a trade or craft—the element of human judgment is always present; it is the outstanding characteristic of a profession. The exercise of judgment can never be reduced to the pat application of rules of thumb.

Whether consciously or not, Mr. George O. May, the author of these two volumes of collected papers published under the title, *Twenty-Five Years of Accounting Responsibility 1911-1936*, very definitely evidences recognition of his responsibility to his profession. I am inclined to think that this recognition on his part is one of the things that mark him over the years as one of the leaders of his profession. The growth of a profession is never attributable to one individual, but the reader of these volumes must acknowledge that the author has been at the front in every worthy effort of the profession, always ready to work with his fellows for the advancement of his profession.

This collection of papers, written over the period 1912-1936, is a fine record of contribution to the substantial and timely literature of the profession, and it was a particularly happy and gracious act on the part of his partners to collect them and present them to Mr. May on the twenty-fifth anniversary of his leadership of the firm of Price, Waterhouse & Company. In this short review, I shall not attempt a critical appraisal of them, but I do want to point out the breadth of Mr. May's interest by indicating their extent. The two volumes comprise some 773 pages of material, divided into seven parts, as follows:

- Part I, of thirteen chapters devoted to various aspects of the Profession of Accounting
- Part II, of seven chapters covering the topic Depreciation
- Part III, of ten chapters treating of some of the problems of Valuation



Part IV, of ten chapters devoted to the Regulation of Securities, chiefly as related to the practice of accountancy but with considerable attention to the political aspects

Part V, of sixteen chapters, of which eleven treat of Taxation in general and five of some phases of Taxation and Accounting

Part VI, of three chapters devoted to a consideration of the Influence of Accounting on the Development of an Economy

Part VII, of seven chapters covering Reviews and Criticisms

The editor, Mr. B. C. Hunt, on whom fell the task of selection, organization, and arrangement, is to be congratulated on a well-balanced volume.

These two volumes will find a place in every professional accountant's library and are worthy of a "seat of honor" in every collection treating of the different professions.

ROY B. KESTER

Columbia University

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*The Development of the Business Corporation in England 1800-1867*, by Bishop Carleton Hunt. Cambridge, Massachusetts: Harvard University Press. Harvard Economic Studies, Volume LII. 1936. xii, 182 pp. \$2.50.

Mr. Hunt's personal belief is reflected in his remark about Parliament's placing the corporate form under lock and key after the South Sea Bubble burst, when, as he says, "Circumstances, it would seem, called loudly for legislation which would, while facilitating incorporation, provide safeguards against fraud in promotion and management." His thesis is that it required a struggle of two centuries to bring about in England the recognition of a place for the limited liability company, the thing we know as a corporation, as an ordinary instrument for private enterprise. He depicts this struggle in details that he draws with equal ease from newspaper files, parliamentary debates, economic pamphlets. His bibliography is a joy to behold, and his use of it masterly. But in this mass of detail he never loses sight of the struggle for emergence of an idea—the need for the limited liability company. This idea itself is controversial. Not only does Mr. Hunt quote *The Times* against it seventy-five years ago, but at the end of his book he comes upon the discovery that Professor Heckscher in our own day again minimizes the importance of limited liability. The truth perhaps lies in the middle. The principle of limited liability carries with it obvious evils that have been emphasized from time to time and that have turned men against it as a contributory cause of depressions. On the other hand, in England as well as in America it has facilitated the accumulation of capital for private enterprise on a scale hitherto unparalleled in history.

The wisdom of keeping in sight the evolution of the idea of the modern corporation through the maze of minor details, personalities, accidents, and incidents in its history is readily suggested when we realize that American business law through an entirely different series of details has in approximately the same period reached the same goal. Beginning in 1800 with a

corporation law that was dependent on specific acts of incorporation by legislatures, granted only to public or semi-public enterprises, we reached at the end of the Civil War a period in which incorporation was accomplished by general statutes and open to every variety of business. There remain, however, certain differences which may be traceable in part to the divergent histories, but in a greater measure no doubt to the different needs, of the two countries. It is striking, for example, that the joint stock company was able to organize itself as a huge partnership with transferable shares and concentration of powers though not endowed with limited liability in this country, but that it never became one of the important modes for the bringing together of capital in competition with our easily organized corporations, on the one side, and our various types of statutory limited partnership, on the other. It is striking, too, that the limited partnership was made possible in one state after the other in this country a half century before it was adopted in England. The explanation may be that there were relatively larger fortunes available in the hands of small groups for the carrying on of the big business of England at that at the same time there was no economic necessity for large-scale operations of the kind that developed in America in the last quarter of the nineteenth century. Another contributing factor may have been competition among our states which resulted in very lax and easy corporation laws, such as some of the states resisted and probably would have resisted more successfully had they been in a position of isolation comparable to that of England. Mr. Hunt is not concerned with any direct comparison with America or the lessons that the English experience has for us, and yet there are passages, including quotations neatly selected from contemporary sources, that are strikingly suggestive of current conditions and comment throughout the book. In the days of the South Sea Bubble there were those who found in the joint stock system "the sole and sufficient explanation of the miseries of the country," and the act passed reflected more anger than deliberation. A century later, England was enjoying a boom, described in the King's speech: "There never was a period in the history of this world when all the great interests of the nation were at the same time in so thriving a condition" (p. 37). The record continues: "Most of the promotions were to perish in the crisis which followed the exuberant prosperity of 1824-25." There were, in fact, several "manias" of promotion, each followed by a day of reckoning, and in each case belated parliamentary action was the result—but not until 1867 did Parliament seem quite willing to go to what our author considers the root of the matter by making the organization of limited liability companies a privilege to be recognized as of common right. With this achievement the book ends. That human nature was not changed, and that stock gambling, booms, and depressions have recurred since, is a theme for another study.

NATHAN ISAACS

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*The Decline of Competition*, by Arthur Robert Burns. New York: McGraw Hill Book Company, Inc. 1936. xiv, 619 pp. \$5.00.

*The Modern Economy in Action*, by Caroline F. Ware and Gardiner C. Means. New York: Harcourt, Brace and Company. 1936. xi, 244 pp. \$1.60.

These two books, although quite different in style and scope, have a considerable similarity in theoretical background and conclusions. Both are closely related to the idea, recently emphasized in certain theoretical studies, that much of the competition that occurs in our society is the competition of monopolists. With this as their point of departure from the conventional economic analysis, the authors proceed to a more realistic consideration of business practises and problems of economic policy than has been provided by the theoretical literature on monopolistic competition. The difference between the attitude on questions of social control resulting from the newer and less widely accepted doctrine and that promoted by the conventional theoretical orientation is brought into bold relief in these volumes. Their main theme is that the failure of competition to yield satisfactory results is neither limited to a few industries affected with the public interest nor to situations resulting from the predatory propensities of a few individuals, and that the measures of social control required are far more extensive than those for which any excuse can be found in the more usual neo-classical economics. The authors have thus undertaken to demonstrate the need for a broad control of industry in the light of the general interest. Neither book, however, leads simply to a plea for an all-controlling government. The discussions of problems of social control are characterized by concern that the control contended for should be accomplished within the framework of political democracy, with a minimum of coercion and with a maximum of decentralization.

In the introduction to his book, Professor Burns discusses the failure of competition to function, under present conditions, as the classical economists expected. He attributes this failure principally to developments in industrial technique during the past half century, but also in some measure to corporation and patent laws. He believes that no anti-monopoly legislation which has been enacted or proposed can compel business to operate according to competitive formulae. In his opinion, competitive processes, as explained by nineteenth century economic theory, have been undermined by more fundamental phenomena than combinations in restraint of trade and the elimination of rivals through "unfair" competitive practises. In fact, he suggests that the trust movement itself was the result of the prior appearance of monopolistic elements in many industries accompanying the decline in the numbers of directly competing firms. The literature dealing with trusts and pools, Professor Burns contends, has been too much concerned with the application of naïve tests of competition and monopoly to throw

much light on the consequences of the practices of business enterprises whose situations conform with neither the ordinary conception of monopoly nor the economists' conception of competition. The theory of "imperfect" or "monopolistic" competition, he thinks, has provided a more fruitful approach to the study of business practises.

The body of Professor Burns' book provides an elaborate and documented survey and analysis of market and production policies and inter-firm relations in several industries. Trade associations, price leadership, the sharing of markets through agreement or fear of reprisals, the stabilization of individual prices, price discrimination, non-price competition, and the integration of industrial operations are all subjected to penetrating examination. The book provides the best analysis of commercial policies that has come to the reviewer's attention.

It does not appear, however, that Professor Burns, in his analysis of commercial practises, has been able to make much use of the more refined parts of the theory of monopolistic competition. The realities of the situations in which business policies are formulated are incapable of being expressed in terms of an elaborate geometry. It is not, therefore, in any precise and finely drawn conclusions regarding the practises of business enterprises in various situations, but rather in marshalling the material in support of the general thesis, that the book has its chief importance and distinction. The characteristic policies of business are shown to result from situations which however different in details are alike in that they render inappropriate the conclusions of conventional economics regarding the results to be expected from unregulated enterprise.

The tenor of Professor Burns work is well illustrated in the chapter on industrial policies under the National Industrial Recovery Act. His appraisal of the procedure and activities of the Government under that act is unfavorable. The codes, he points out, operated to increase the concentration of control in each industry and the administration's policy "was directed to considerations no more fundamental than an estimate of what the representatives of industry would accept without protest." His discussion of this experience, however, is tempered by the conviction that the market and production policies followed under the Act were not as different from those ordinarily pursued by business organizations as conservative criticism of the Act implies. "The abandonment of the National Industrial Recovery Act," he says, "provided no solution to the problem of adapting economic institutions to an industrial system diverging increasingly from free competition. . . . The state cannot by refraining from positive control obtain the benefits of free competition. On the other hand, state participation in price policies presents profound and complex problems both economic and political. Yet some such participation is inevitable."

The final two chapters of Professor Burns' book are devoted to discussions of the general objectives of social control and the means by which these ob-

jectives may be attained. He describes the objectives in abstract and general terms and has not attempted to indicate their practical application.

The Ware-Means book is a less formidable volume. It is somewhat in the style of pamphlet literature and intended to appeal to a wide audience. Its purpose is to contribute to the formation of a new "climate of opinion" in replacement of that predisposition in favor of *laissez faire* which early nineteenth century economics promoted, and which later economics in the classical tradition has continued in the main to sustain. The authors feel that what is needed to develop sound popular thought on present social problems is not chiefly additional factual information but reconsideration of the underlying assumptions on which current "common sense" attitudes are based. The facts of every day observation, they contend, are patently out of conformity with the views of affairs which most people entertain; yet these views persist simply because their basis is seldom questioned. The book contains little factual information that is not common knowledge. The argument itself is reduced to its absolute essentials. Sixty-two small pages suffice to explain why the ideas at the basis of the prevailing habits of thought were reasonably appropriate in the "old economy" but are ridiculous in the "new." The displacement of flexible competitive prices by administered monopolistic ones in a large segment of industry is, of course, what makes the difference. More emphasis is laid, however, than in the Burns book on the effects of the changed conditions on the working of the system as a whole—the tendency of disturbances to cause increasingly severe maladjustments.

After thus preparing the reader, Miss Ware and Mr. Means proceed into a brief survey of the whole run of problems of the relations of government to industry and business. In this survey, the authors employ several lines of analysis that have been presented with much greater elaboration in other treatises. Though such parts of the argument are much simplified for the purpose of maintaining the interest of the general reader, it appears to the reviewer that the book deserves the attention of professional economists. Some of the elements of the analysis are more convincing when definitely integrated with the authors' price analysis than when they are regarded as refinements or additions to the strictly classical economics.

Many questions regarding the remedial measures proposed by Miss Ware and Mr. Means are not answered in the book, as they are well aware; but in the reviewer's opinion, they have made a persuasive and readable contribution toward the creation of the "climate of opinion" in which problems of social policy need to be considered.

L. A. MORRISON

United States Tariff Commission

*The Economics of Open Price Systems*, by Leverett S. Lyon and Victor Abramson. The Brookings Institution, Washington, D. C. 1936. xii, 165 pp. \$1.25.

The Brookings Institution has added another to the posthumous offspring of the National Industrial Recovery Act, already both remarkably numerous and promising. The present study traces the development of the cooperative collection and dissemination of information concerning prices in the markets for manufactured goods and analyses its effect on prices and production, on the small firm and on industrial integration. The authors set out the criteria of social usefulness in open price systems and discuss the industrial situations to which they are appropriate and the proper policy of social control. The discussion is admirably lucid and orderly, yet it falls short of one of its stated objectives, viz., to offer constructive aid to business men and government officials.

The problem is to design the most suitable environment for the price making process. Drastic changes in conditions of manufacturing and marketing during the past hundred years have compelled business men to adapt their market behavior, and the reconsideration of public policy is an urgent necessity. In three and a half tenuous concluding pages on this subject the authors come very near to the reported instruction of a public official on a difficult and important matter of public policy, viz., "let the appropriate officer take the appropriate action." Aside from comments upon administrative techniques they remark that open price systems would be differently devised according as they are intended to facilitate "informed competition" or further a system of state cartels; they call, therefore, for a clear declaration of public policy concerning unfair competition by the appropriate legislative and judicial bodies. But the remainder of the study is infused with a preference for the facilitation of "informed competition" and with a belief in the possibility of the restoration of a competitive individualism that will result in the best use of economic resources after the manner outlined in their preliminary exposition of the operation of such a system. Accordingly, they judge the social desirability of various types of open price system in terms of their capacity to induce this "informed competition."

Ignorance and misinformation obviously exist in many markets, and open price systems could diminish these sources of irrational operation. But they may go further. The authors point to their capacity to induce or facilitate price agreements and stimulate forms of indirect pricing. Refusal of permission to establish open price systems would not, of course, restore competition in such markets, but its universal establishment is not the present problem of the authors. They point also to the possibility that such systems will reduce to vanishing point the interval of time in which firms can attract business from rivals by price reductions. But they contend that secret price cutting involves discrimination and breeds bad feeling. More fundamentally, they conclude, it is objectionable because it may result in an ill informed and unwise allocation of resources. But it should also be emphasized that

knowledge reduces the downward pressures upon prices and also thereby affects the allocation of resources. It is questionable whether the criterion of the smoothly operating market lubricated by information yields any adequate general basis for the establishment of the most desirable environment for price making.

The solution to this problem in particular markets involves a knowledge of conditions in the market because, as the authors emphasise, systems vary in their manner of operation from one industrial situation to another. But research into the operation of particular systems is an indispensable prelude to even general guidance to business men and public officials. The present work relies upon the few studies already made and tends, therefore, to a marshalling of possible relations of cause and effect without adequate appraisal of their relative significance. An investigation of the actual operation of such systems seems peculiarly appropriate to a research institution, and it is to be hoped that the Brookings Institution will use the present work as the ground plan for such an investigation.

ARTHUR ROBERT BURNS

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*Minimum Prices under the NRA*, by Herbert F. Taggart. Michigan Business Studies, Volume VII, Number 3. 1936. viii, 307 pp. \$2.00.

As chief of the Cost Unit of the Research and Planning Division of the NRA for a considerable period, Professor Taggart was required to play an active part in the efforts of that agency to establish minimum prices and minimum prices bases. It is particularly interesting, therefore, to have his report on the subject of minimum prices under the NRA.

The book consists of eleven chapters. Two are introductory; one deals with legal and administrative matters; one is a final appraisal; and seven are concerned with specific bases for or forms of minimum prices. The titles of these seven chapters well state the categories into which minimum prices under the NRA may be placed. They are: Bases for Minimum Prices: Average Cost; Bases for Minimum Prices: Lowest Cost; Bases for Minimum Prices: Individual Cost; Bases for Minimum Prices: Other Cost Bases; Minimum Prices not Specifically Based on Cost; Loss Limitation; Emergency Minimum Prices. These chapters necessarily constitute the body of the volume and that segment of material with which Professor Taggart may be supposed, both by professional training and NRA experience, to be highly qualified to deal.

Although in such a study from an accountant, one naturally looks for and regrets the absence of a survey of the problems involved in the establishment of uniform cost accounting methods in connection with NRA minimum price fixing, this is deliberately excluded, the author explaining that it will be published in a separate volume. Each chapter is in the nature of a general running account, including an explanation of the type of minimum price

fixing under discussion, in some instances an explanation of exceptions which were permitted, a series of illustrations of applications to various industries, intermixed with comments by the author, and arguments for and against this particular type of price-fixing as expressed by those in authority within the NRA and by proponents and opponents inside and outside of the organization. There is also in most instances some appraisal of administrative effectiveness.

In discussing lowest cost as a base, for example, the author cites the first use of this standard (in the code for the millinery and dress trimming braid and textile industry, approved October 31, 1933) and sets forth the language in which duties under this standard were imposed upon the code authority. This agency was required to "compute the lowest reasonable cost of production of products in the industry, which shall be determined as follows: It shall, from time to time, but not less than once each year, through certified public accountants, approved by the Administrator, compute the lowest reasonable cost of production on a fair basis. When this lowest reasonable cost has been approved by the Administrator, it shall be proclaimed by the Code Authority and shall be binding upon all members of the industry."

But the code, says the author, "set up no definition of 'lowest reasonable cost,' and no standards by which it might be known." The intention, he continues, "was to formulate a list of minimum prices, and the phrase was probably invented in an effort to make the scheme appear harmless." The interpretative vicissitudes to which this phrase was then subjected inside and out of the NRA are recited. The secretary of one code authority is reported as having hailed it as giving "to all industries the right to fix prices on the same basis granted to the lumber industry," and expressed his opinion that the "new policy" opened up "new vistas of profit for industry."

The introduction of this standard into other codes led to added interpretations and added problems. It was adopted as the minimum price basis for "emergency purposes" in nearly one hundred codes and supplements. The chief difficulty in its administration, says the author, "lay in the fact that the provisions must be put into effect on the basis of cost data gathered and presented for approval." This, he declares, is "an almost hopeless task in the many industries in which uniform . . . cost accounting methods are practically unheard of." "The Administration," he observes, "was wise when, in formulating the emergency price basis for Office Memorandum 228, it abandoned the expression 'lowest reasonable cost.'"

Similarly is traced the NRA's experience with the other forms of minimum price base and minimum prices. In a general statement the author observes, "Broadly speaking, the attempts at setting minimum prices failed. They not only disregarded fundamental economic doctrines, but they were so subversive of the entire philosophy of anti-monopoly legislation that it was impossible to secure their legal enforcement. They lacked the unanimous support of the members of industry whom they were supposed to help and, as might have been anticipated, failed to obtain the favor of consumers."



On the basis of his own presentation of data it would seem that he might well have added, "and perhaps most of all on the grounds of the impracticability of determining a real meaning for the standards declared."

Of the four more general chapters of the book, that entitled *Legal and Administrative Background and Cases under the NRA* seems to the reviewer the most effective. I find some question regarding a number of points in other chapters. For example, the author opens with the statement, "The NRA was foreordained to failure." He points out "that accomplishments were arrived at through bargaining" and concludes, "It was through this procedure that the NRA became a measure both of recovery and of reform and thus dissipated its energies by attempting to cover far too much ground too quickly."

It seems to me a more accurate view that it was the Recovery Act itself which embodied both recovery and reform. It was the law which seems to me to have compelled the type of procedure which was followed. Indeed, the President declared that the law was concerned alike with getting "many hundreds of thousands of the unemployed back on the payrolls." and with planning "for a better future for the longer pull."

More significant, however, were the procedural provisions of the law. Either mandatory or "voluntary" codes were possible. When the choice was made in favor of voluntary codes, the bargaining procedure with all that it entailed became inevitable. It was industrial groups which were authorized to come forward and to volunteer codes of fair competition. (Section 3(a) of NIRA.) It is obvious that such groups would, typically—particularly in view of the modification of the anti-trust laws embodied in the NIRA—present proposals for their own benefit rather than those directly concerned with increasing employment and wages and reducing hours. To secure in *voluntary* codes provisions of the latter type, believed by the Administrator to be essential to recovery, a bargaining procedure was imperative. Once the decision was made to use voluntary codes, there was for the Administrator no alternative to a bargaining procedure.

In a final chapter dealing with appraisal and critique of minimum price fixing, the author has employed, I think, an admirable technique in setting out and commenting upon a series, first of economic assumptions, and then of practical assumptions which underlay minimum price fixing in the NRA. Most of both he believes unsound, or at best questionable. In some of these I find that I should prefer a somewhat different statement—perhaps a different analysis. For example, page 242, "Economic Assumption No. 1: That unsatisfactory price phenomena are industrial ills of themselves, rather than mere symptoms. The actual ailments of industry were, at the time the NIRA was enacted, and still are too fundamental to be cured by a mere attack on price. Industry was suffering, first and foremost, from a severe and prolonged depression. Artificial stimulation of prices would, if anything, prolong and intensify this disease." Such a statement is gratifying (excepting that the phrase "unsatisfactory price phenomena" leaves one wondering, unsatisfactory to whom). But the next sentence reads, "More fundamentally, industry

is afflicted by the tremendous increase in capacity created by technological advances. . . . " In view of many other statements in the book, it seems that Professor Taggart seriously shifts his points of reference, when he suggests that our increased capacity and technological advances are industrial afflictions.

A somewhat similar example is to be found in "Economic Assumption No. 2" (page 242) which reads "That every business is entitled to a profit. It would be closer to the truth to say that a business is entitled to a profit only when it earns a profit." Why say it is *closer* to the truth, rather than the truth? The paragraph concludes with the sentence, "However, if all businesses were entitled to a profit, and such a rule were to be enforced, a good deal of economic motivation would be lost." This seems a rather feeble summary of the issue at stake.

These illustrations perhaps serve to indicate the characteristics which make the four more general chapters less satisfactory than those which deal directly with what may be called the "inside stuff" growing out of the author's close experience with the NRA.

Professor Taggart's general style and method are very refreshing. He explains early that he "has drawn freely on notes and memoranda made during his connection with the NRA." This fact adds to the book's contribution to the record of the Recovery Administration. With comment on those both inside and outside the NRA and with the quotations from them, he lays about him with that freedom which is conventionally designated as calling a spade by its real name. He cites a pronouncement of the National Industrial Recovery Board (this was after the resignation of General Johnson) as "an excellent example of the ineptitude of many of the public announcements by the Administration." He says, "Read carefully, the statement is very fuzzy. Its meaning is vague" (page 45). He even conjectures on what the NRA might have been with what he calls a "stiffer spined Administrator."

LEVERETT S. LYON

The Brookings Institution

*British International Gold Movements and Banking Policy. 1881-1913*, by W. Edwards Beach. Cambridge, Massachusetts: Harvard University Press. Harvard Economic Studies, Volume 48. 1935. xiv, 211 pp. \$2.50.

The contribution of this scholarly study consists in the presentation of valuable material, statistical and descriptive, concerning a somewhat neglected epoch of English monetary history. Two chapters deal with the statistical data proper, presenting them as series, preferably with trends eliminated, of external and internal gold flows; of bullion and notes in the Bank's figures; cash holdings and balances of the commercial banks; money rates; index numbers of the general price level, and other cyclical indices. The series are based mostly on critical analysis of the sources and provide

excellent raw material for future studies. In the present study, however, they do not seem to serve for much more than to demonstrate that during the upturn, in England as in America, the central market tends to gain gold from the outside and to lose gold to the interior, whereas the flow tends to be reversed in the depression (pp. 38-104). Exceptions, such as the heavy gold imports in the stagnation period between 1893-94 (p. 127) are not accounted for. More insight is displayed in the descriptive chapters (pp. 105-151) with their rich material on the history of the London money market during the period under review. They amount to a very instructive analysis of money market cycles and of the Bank's policies to cope with them, with emphasis on the gold movements. Many details disclosed by this painstaking piece of research are highly relevant to diverse aspects of present-day monetary discussion.

The difficulty in appraising the study as a whole arises, however, when one attempts to corroborate its empirical approach with its theoretical pretensions. The none-too-clear theoretical Chapter II (pp. 7-37) insists on the necessity of using factual data to determine the relevance of cyclical fluctuations to the mechanism which adjusts international balances. But the issue seems to narrow down, as the study proceeds, to that raised in the "introduction" (pp. 3-6), of the relative importance of discount rates and capital movements as compared with commodity prices in bringing about the movement of specie. The conclusion of the author is of course that the former is far more important than the latter; but this is hardly a new contribution. Nor is it sufficiently elaborated, lacking proper analysis of such distinctions as between short-run and longer-run processes, or between major and minor cycles, etc.

Surprisingly, the central theme shifts again in the closing chapters. On the one hand, Chapter VIII (pp. 152-169), after a well-organized and documented analysis of the Bank's relations to the money market, comes to the conclusion that, by 1914, as most of the time before, the "Old Lady" had the market well under control. This result is not entirely convincing and needs revision in the light of a study of the market "organization," and of the "qualitative" developments in the credit structure. At any rate, it is actually contradicted by the next chapter (pp. 170-82), in which the author points out what seems to be his main contention, namely, that central banking policy in the pre-War type of gold standard is badly handicapped by international capital movements. They make any control of a "boom" by discount rates and other methods virtually impossible through attracting foreign funds. How, then, was the Bank more often than not in a position to control the market, as the author himself contends? He does not seem to feel that his criticism of the gold standard based on the one argument is actually offset by the other; and that, of the two, the second has apparently the better foundation in the facts which he has dug out himself.

MELCHIOR PALYI

The University of Chicago

*National Economic Security*, by Arthur B. Adams. Norman, Oklahoma: University of Oklahoma Press. 1936. 328 pp. \$2.50.

This volume presents an analysis of the causes of the depression, a comprehensive and critical appraisal of New Deal recovery and reform policies, and advances a definite program for the furtherance of "permanent prosperity for all." The author finds that the depression commencing in 1929 was not only more severe than any preceding one but that it, and the preceding boom, were basically different in character from earlier cycles. Not only had "a surplus market supply of many classes of goods and a surplus capacity of production in most industries" developed, "long before the beginning of the depression," but in the midst of "our greatest peacetime boom, a surplus rather than a shortage of labor developed." This situation Dr. Adams attributes "to the rapid displacement of laborers by automatic machinery in production." As a result, he says, "there was little increase in real wages" at the time of the great rise in the volume of industrial production. Profits and savings "rose more rapidly during the twenties" while "laborers as a class received less benefits from the industrial upswing" than in any previous boom. And finally, "there was never a time when as large a portion of the national income was saved and invested as in the twenties; also there was never a time when current production exceeded current consumption as much as it did in this period."

Thus Dr. Adams subscribes without reservation to the over-saving under-consumption theory of the depression. This conviction, although not adequately supported by statistical evidence, colors his appraisal of the Roosevelt recovery program and conditions his own recommendations for permanent prosperity. Natural recovery, in his opinion, is quite impossible, for the nation has passed from "an era of a scarcity of capital funds and productive capacity to one of a surplus of capital funds and a scarcity of markets"; it is no longer possible to "exploit vast untapped natural resources"; nor is it likely "that the demand for new equipment or for funds with which to expand existing industrial enterprises will be large in the near future." This last sentence might just as well have been quoted from the report written just fifty years ago by Carroll Wright, the first Commissioner of Labor of the United States. Surveying the amazing accomplishments of the preceding half century from the depths of the first Cleveland depression, Dr. Wright was led to conclude lugubriously that the real work of the world had been completed and that "the day of large profits is probably past." Of course, the fact that Dr. Wright was wrong in 1886 does not prove that Dr. Adams may not be right in 1936, but it does leave room for reasonable doubt.

Although believing that it was necessary for the Government to "do something" to promote recovery, Dr. Adams is far from subscribing to everything that was done under the New Deal program. The Roosevelt monetary policies he deplores as a futile and dangerous experiment which at best might lead to an abortive recovery based on "the quicksand of inflation" rather

than the solid foundation which might have been established by adjustment of production costs to a lower price level. The danger of uncontrolled inflation is greatly enhanced, in the author's judgment, by continued deficits and increasing public debt which, if continued much longer, will lead to paper money.

The Administration measures designed to relieve agricultural and urban debtors and the Federal regulation of securities and exchanges enlist Dr. Adams' sympathy, but he is less enthusiastic about the relief program, and toward social security he is only lukewarm for, "the kind of economic security which is most vital is that security which comes from opportunities to earn a good living and provide for family and old age."

The author's own recommendations are based upon his belief that, "the fundamental economic difficulties which stand in the way of national progress and greater economic security are unemployment and unequal distribution of income in the nation." Because too large a share of the nation's income goes to those who save and invest and too small a share to those who spend, "the operation of the so-called natural economic laws cannot be depended upon either to eliminate unemployment or to give to the mass of consumers adequate purchasing power with which to buy the goods industry can produce." To correct this condition "the Federal Government must exercise more regulation and control . . . over the distribution of the national money income and over the weekly hours of laborers." Large incomes and inheritances must be redistributed by taxation and interest, profit and wage rates so controlled as to give small income receivers a larger share, while the unemployed are to be "absorbed" by adoption of the thirty-hour work week.

The farmers, too, would be regimented with a vengeance under Dr. Adams' scheme, and with no nonsense about benefit payments. The Federal Government would be given "power to allot to each farmer the maximum quantity of each major agricultural product he may be permitted to produce and sell each year," with "heavy penalties for those who exceed their production allotment."

Curiously enough, after bestowing the blessings of regimentation and monopoly on labor and agriculture, Dr. Adams would deny them to industry. Any and all "agreements by industries through trade associations or otherwise in reference to prices or volume of production" would be prohibited and the "anti-trust acts against monopolistic activities and restraints of trade" would be rigidly enforced, although a "limited amount of self-regulation of trade practices" would be permitted. Federal incorporation would be required for all inter-state business and the evils of over-capitalization and corporate financial manipulation would be eradicated by vigorous Federal regulation.

Thus Dr. Adams' Utopia appears to be a curious mixture of free competition and government planning, of collectivism and individualism, of an economy of scarcity and an economy of plenty, of sharing wealth and sharing poverty. Whether or not the program advocated by Dr. Adams can be ac-

cepted in its entirety as being sound or feasible, however, his book can be highly recommended as an able exposition of the problems of the depression and of the governmental measures adopted to solve them.

FREDERIC DEWHURST

Committee on Social Security  
Washington, D. C.

*\$2500 a Year*, by Mordecai Ezekiel. New York: Harcourt, Brace and Company. xv, 328 pp. \$2.50.

One of the economists of the Department of Agriculture, intimately acquainted with the procedure of planned restriction of output under the A.A.A., and also familiar with the type of industrial planning tried under the N.R.A., here addresses himself to the problem of bringing about balanced and steadily increasing production by industry for the purpose of raising the general level of living, and doing so without a social revolution which might substitute a different system for capitalism.

His premises are the generally conceded ones that we have the equipment, skill, and labor energy to turn out many more goods than we have produced even in prosperity, and that the chief obstacle is lack of purchasing power, arising from maladjustments among prices, wages, and production schedules. It is possible, he believes, to work out a rough sketch-plan or blueprint for a national economic program, specifying increases in output for the several industries, and balancing the industrial programs with one another so that just the right amount of materials would be available for the processing industries, and the finished goods would be adjusted in quantity and variety to the demands of the population for a higher standard of living. It would also be possible, with increased output, to adjust wages and prices so that effective demand for the goods produced would clear the markets, without abolishing profits, and even while somewhat increasing them. The task of elaborating such a program in detail is admittedly one of enormous difficulty, but Dr. Ezekiel presents a thoughtful treatment of the major problems involved and a number of fertile suggestions for attacking these problems.

The unique contribution of the book, however, lies not in these fields, which have been the subject of much discussion in recent years, but in the suggestion of a politico-economic technique for putting the program into effect. How can private business be induced to have faith in such a scheme and cooperate in effectuating it? Dr. Ezekiel suggests a modification of the A.A.A. plan. After the blueprint program was worked out industry by industry, and the desired amount of production was allotted to the single members of each industry, the several employers would be given a chance to sign voluntary contracts, by the terms of which the Government would offer bonuses to those who agreed to produce given amounts at given prices and at given wage levels. The output, prices and wages would be so calculated as to provide to the cooperating concerns a larger volume of profits

than at present, though the profit per unit would be cut by price reductions or wage increases. The bonuses would be supposed to offset any additional gains that might be made by concerns which declined to cooperate and operated at lower wages and higher prices. Money for the bonuses would be collected from processing taxes or general sales taxes, but these would not be sufficient to counteract the benefit to consumers from the larger output and purchasing power which operation of the program would bring about. It would be safe for each individual concern to enlarge output because of the planned assurance that employment and demands for materials would steadily grow throughout industry—a condition which now does not obtain during the recession and depression phases of the cycle.

The difficulties obvious in such a plan are briefly discussed by Dr. Ezekiel. He believes that labor would cooperate, given advancing real wages and reasonable adjustment machinery. He suggests the introduction of flexibility in quotas to allow for the superior energy or better management of new or progressive companies. In the reviewer's opinion, he devotes far too little consideration to the questions involved in the existence of marginal and high-cost units. Any quota plan, whether for reducing or increasing output, is likely to fall afoul of a wide distribution of costs in any given industry. This would be particularly disastrous in a scheme which seeks as a major objective greater economic efficiency. The problem is not so grave at a time of depression (and the book was written with an eye on the desire for recovery), but when fuller operation has come it might be crucial. Such major collateral questions as the control of investment and credit in pursuance of the program also receive scant consideration.

In spite of inevitable defects in a pioneer endeavor of this sort, the book is ingenious and would have a substantial social value if what our society primarily needed were more intelligence and could use rational suggestions for reform, no matter how far-reaching. It is not likely, however, that a thoroughgoing plan like this would be adopted by either industry or government except at a time when social collapse was so imminent that something less rational or more drastic were the more probable outcome.

GEORGE SOULE

The New Republic

*Consumer Market Data Handbook: 1936*, by Raleigh W. Dawson. Washington, D. C.: U. S. Department of Commerce, Bureau of Foreign and Domestic Commerce. Market Research Series No. 15. June, 1936. iv, 373 pp. 50 cents.

The third in a series of important steps which the Department of Commerce has taken toward the elimination of waste in distribution, through the assembly of market statistics and their presentation in readily usable form. Prior to 1929, when the first of the handbooks was issued, it was necessary for those engaged in measuring markets and setting up sales quotas to turn to many sources, both governmental and private, in the search for

data. Up to that time, furthermore, a number of the series now appearing in the handbooks were not available to the general public in any form.

The present volume contains two major tables, the first including data on population, retail and wholesale sales, service, amusement and hotel receipts, postal receipts, personal income tax returns and wired homes; and the second dealing with motor vehicles registered, residence telephones, number and value of farms, A.A.A. payments, the number of persons on relief and relief expenditures. The first table gives figures for all incorporated places of more than 2,500 population, for the remaining area within counties, and for counties as a whole. County totals represent the smallest subdivision of the second major table. For a number of series, per capita data and percentage relationships are given—a great saving of labor on the part of users of the book since, by inspection, they can detect the relative purchasing power of the various areas as denoted by the series in question.

The introduction provides a useful guide to statistical technique in establishing market potentials. Illustrations of the actual application of marketing data to the problems of distribution should prove highly suggestive to business men who wish to increase the efficiency of their sales operations. In addition to its usefulness to distributors of consumer goods the handbook should be of interest to banks, publishers, students of marketing, and to anyone interested in the standard of living of persons residing in particular geographic areas.

A few minor criticisms come to mind. From the standpoint of convenience in reading the figures, the format of the tables could be improved. One series of data—per capita retail sales for rural areas—might profitably have been omitted. Since this series denotes merely the sales of outlets in rural areas prorated over the population in those areas, it is not significant as an index of buying power of persons residing in places of less than 2,500 population.

On the whole, the 1936 handbook represents a step forward in market research. With its predecessors it affords an indication of trends, which, it is hoped, may be continued in later editions. Thus a body of statistics would be made available which would reveal changes in consumer standards in the components of the national market over a period of years.

PAUL W. STEWART

Anderson, Nichols, Associates, Inc.  
New York, N. Y.

*World Immigration, with Special Reference to the United States*, by Maurice R. Davie. New York: The Macmillan Company. 1936. x, 588 pp. \$3.75.

Professor Davie has written a book on immigration that is a pleasing exception to the common run of dry-as-dust repetitions of the statistics of the number, age, sex, and country of origin, etc., of the "old" and "new" immigration. He also departs from the traditional treatment of the problem in that he pleads no special cause. The central theses, if such they may be called, are: First, that immigration is largely a middle-class movement and,



secondly, that the problem of the future in countries with a highly restrictive immigration policy is "largely one of assimilation." The book decidedly is not a treatment of the subject "upon the broad basis of the universal restlessness of man," as it has been characterized by one reviewer.

The first few pages give the usual class-room distinctions between "colonization," "immigration," "invasion," and "conquest." But this class-room pedantry lifts very rapidly, and Professor Davie's sense of the real asserts itself with compelling force. There follow nearly six hundred pages of the story of the thrilling adventure of tens of millions of people, who in their ceaseless search for a freer and more abundant life have, in the past one hundred years, populated three new continents. The author endows his statistical material with a peculiar freshness and meaning, and he balances argument and counterargument with a detachedness that carries conviction. With almost artistic deftness he manages to lift from their original domicile more than a score of races and creeds and nationalities, to follow them in their voyage across the lands and seas; to evaluate the reasons for their leaving the homeland and the vicissitudes of settling and acclimatization in the new lands; to characterize the cultures, the racial heritages, and the economic rivalries of these diverse peoples, as they clash in the countries of emigration and immigration, endowing it all with a sense of sympathy and good humor rare in scholarly literature.

Professor Davie is uncommonly aware of the futility of definitive characterization of the effects of immigration. He is not one of those "students of the immigration problem" who at one and the same time dogmatically assert that immigration has been both the cause of the growth of trade unionism in the United States and an impediment to that growth; that it has caused both the acceleration and retardation of the introduction of labor-saving devices in American industry; that it has been the cause of the decline in the birth rate as well as the contributor to an overpopulation of not quite the right sort of humans; that immigration was responsible for our slums and our juvenile delinquency and pauperism and crime, feeble-mindedness and the insane, and for our corrupt politics and the Continental Sabbath. He is not convinced by the "proofs" of the eugenicists that our "new" immigration is racially inferior to the "old" immigration, as, apparently, the old immigration had been inferior to the yet older immigration, back to Leif Ericson. He does not agree with a certain group of university sociologists that our immigrants are "descendants of those that always stayed behind." Professor Davie has read his history and is aware of the fact that the immigrants of every generation were so thought of by the immigrants of every preceding generation.

Professor Davie has delved deeply into the almost inexhaustible literature of the field. The bibliographies, given at the end of each chapter, are the most exhaustive that this reviewer has come upon in any one volume or series of volumes on this subject. In its completeness and with respect to its topical arrangement, it is in itself a rich contribution to the literature.

The reviewer has but two major criticisms to offer. Professor Davie no-

where attempts to substantiate his thesis that immigration is of an "essentially middle-class nature." Indeed, Professor Davie is fully aware of the fact that immigration to America has been mainly a movement of the European peasantry and laboring classes (pp. 253 ff., p. 244 particularly). With reference to the period since 1880, Professor Davie states (page 238): "Recent immigrants have been largely peasants and farm laborers from the less industrialized countries of Europe. About four-fifths are unskilled laborers without previous experience in mining and manufacturing yet they find work mainly in these industries."

Secondly, Professor Davie fails to do full justice to the question of the circumstances that led, in 1924, to the complete reversal of our century-long immigration policy. How did it happen, after a century of apparently irreconcilable opposition between capital and labor in the matter of free immigration, that capital suddenly, apparently, capitulated to labor's historic demand for restriction? What were the historic moments of the time? Professor Davie missed fire here. Undoubtedly, this is due to his failure to perceive the essentially selfish role played by the earlier labor organizations of skilled crafts in this country in their almost overt collaboration with their employers in the harsh treatment of our immigrant labor.

Admittedly, these are questions that require considerable study, not possible in a volume replete with so much other material as is *World Immigration*. Perhaps Professor Davie was aware of this fact. Let us hope that in the not very distant future a scholar of Professor Davie's mettle, possessing the facility and felicity of his pen, will undertake such a study. In these questions lies the essence of world immigration.

JOSEPH M. GILLMAN

Washington, D. C.

*The General Theory of Employment, Interest and Money*, by John Maynard Keynes. London: Macmillan and Company. 1936. xii, 403 pp. \$2.00.

A book by Mr. Keynes on fundamental questions which are right at the heart of the practical discussions of the day is no doubt an event. Those who had the opportunity to witness the expectations of the best of our students, the impatience they displayed at the delay in getting hold of their copies, the eagerness with which they devoured them, and the interest manifested by all sectors of Anglo-American communities that are up to this kind of reading (and some that are not) must first of all congratulate the author on a signal personal success, a success not in the least smaller in the cases of negative reaction than in those in which the book elicited fervent admiration. The unfavorable reviews in a sense but testify to the reality of that success, and I for one, being about to write another of those unfavorable reviews, heartily rejoice in this implication and wish it to be understood that what I am going to say is, in its own unconventional way, a tribute to one of the most brilliant men who ever bent their energies to economic problems. Expression of a teacher's gratitude should be added for the gift of

what is, in its vigorous exposition and extreme simplicity, an invaluable starter of discussions. Speaking to us from the vantage ground of Cambridge and from its author's unique personal position, defended by a group of ardent and able disciples, the book will undoubtedly dominate talk and thought for some time.

In his preface Mr. Keynes underlines the significance of the words "General Theory" in his title. He professes to address it primarily to his fellow economists and seems to invite purely theoretical discussion. But it is not quite easy to accept that invitation, for everywhere he really pleads for a definite policy, and on every page the ghost of that policy looks over the shoulder of the analyst, frames his assumptions, guides his pen. In this sense, as in another, it is Ricardo all over again. The advice offered implicitly and the social vision unfolded explicitly, do not concern us here. That advice (everybody knows what it is Mr. Keynes advises) may be good. For the England of today it possibly is. That vision may be entitled to the compliment that it expresses forcefully the attitude of a decaying civilization. In these respects, this book invites sociological interpretation in the Marxian sense, and nothing is more certain than that such interpretation will be administered to it before long.

It is, however, vital to renounce communion with any attempt to revive the Ricardian practice of offering, in the garb of general scientific truth, advice which—whether good or bad—carries meaning only with references to the practical exigencies of the unique historical situation of a given time and country. This sublimates practical issues into scientific ones, divides economists—as in fact we can see already from any discussion about this book—according to lines of political preference, produces popular successes at the moment, and reactions after—witness the fate of Ricardian economics—neither of which have anything to do with science. Economics will never have nor merit any authority until that unholy alliance is dissolved. There is happily some tendency towards such dissolution. But this book throws us back again. Once more, socialists as well as institutionalists are right in judging economic theory as they do.

Ricardian as the book is in spirit and intent, so it is in workmanship. There is the same technique of skirting problems by artificial<sup>1</sup> definitions which, tied up with highly specialized assumptions, produce paradoxical-looking tautologies, and of constructing special cases which in the author's own mind and in his exposition are invested with a treacherous generality. In one fundamental point it actually falls short of the line already reached by those writers who in the sixties of the past century criticized some of the tenets of what to them was "classical" doctrine,<sup>2</sup> notably Longe and Thorn-

<sup>1</sup> The definition of involuntary unemployment, page 15, may serve as an example. Taken literally (which of course it would be unfair to do) it would mean that there is no practically conceivable case in which workmen are not partially unemployed by definition. For if prices of wage goods rise a little, other things being equal, it is clear that both the demand for, and the supply of, labor will increase under competitive conditions, the latter at least as long as the flexibility of the marginal utility of income to the workmen is what present statistics lead us to believe.

<sup>2</sup> Mr. Keynes' definition of the word "classical," which is made to include Professor Pigou, who

ton. These knew perfectly that the old supply and demand apparatus renders its very limited service only if applied to individual commodities, strictly speaking to individual commodities of relatively small importance, and that it either loses or changes its meaning if applied to comprehensive social aggregates. This was in fact their foremost objection to the wage fund theory. Mr. Keynes' fundamental construction (which is all we can consider here) rests on a contraposition of expected<sup>3</sup> net "proceeds," equal to expected profits plus expected current payments to factors (for definition see page 24), and *those* proceeds the expectation of which would be sufficient and not more than sufficient to induce entrepreneurs to decide on producing the corresponding output. Two schedules or functions are imagined in order to describe the behavior and the relation to one another of these two fundamental variables. The analogy of the first with the ordinary Marshallian demand curve and the analogy of the second with the ordinary Marshallian supply curve are obvious. In fact, Mr. Keynes speaks of Aggregate Demand in the one case and Aggregate Supply in the other and makes them yield a unique "point of intersection." There is as little justification for this extension of the "Marshallian cross" as there is for its application to the case of money, which has remained a besetting sin of the Cambridge group to this day.

Transition to the central theme of the book is effected by relating those two fundamental variables not to output but to employment, and not to employment of resources in general but to employment of labor. Mr. Keynes is as careful to point out that number of workmen employed is not proportional to output as Ricardo was to point out that value cannot be proportional to quantity of labor. But exactly as Ricardo reasoned as if it were, so Mr. Keynes assumes that employment of labor is an "adequate" index of the output resulting from it. The arguments offered by both authors, in support of what is a procedure obviously inadmissible in anything that pretends to be a "general" theory, are curiously alike. In particular both display a desire to banish the variations of output—or, in Ricardo's case, of "riches"—from the realm of theory.

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cannot be counted among classics by virtue of any criterion except the one of outstanding achievement, reminds me of a little experience I had in a group of students. I observed that one of the members kept on referring to a highly unconventional proposition as "orthodox." I asked him why he did so, seeing that the proposition was no part of received doctrine. His answer was, "I simply call orthodox everything I don't like." Protest should be filed in passing against Mr. Keynes' methods of criticism. But beyond that it is regrettable that so brilliant a leader should set so bad an example of utter absence of *verecundia*. I am no Marxian. Yet I sufficiently recognize the greatness of Marx to be offended at seeing him classed with Silvio Gesell and Major Douglas. Mr. Keynes is unjust even to Major Douglas for there is no warrant whatever for thinking little of that writer once one has accepted the views of this book. Certainly Marx and the classics (in the proper sense of the word) were grievously at fault in very many points as it is natural that pioneers should be. Yet they are right as against Mr. Keynes. His attitude toward Marshall's teaching is for Marshallians to judge.

<sup>3</sup> The emphasis on *expected* as against *actual* values is in line with modern tendencies. But expectations are not linked by Mr. Keynes to the cyclical situations that give rise to them and hence become independent variables and ultimate determinants of economic action. Such analysis can at best yield purely formal results and never go below the surface. An expectation acquires explanatory value only if we are made to understand *why* people expect *what* they expect. Otherwise expectation is a mere *deus ex machina* that conceals problems instead of solving them.

It should be clearly realized what that means. Readers of this *Journal* will shrug their shoulders at a theory which deserts the statistician in his struggle with the momentous problems surrounding the Index of Production. But disregarding this, reasoning on the assumption that variations in output are uniquely related to variations in employment imposes the further assumption that all production functions remain invariant. Now the outstanding feature of capitalism is that they do not but that, on the contrary, they are being incessantly revolutionized. The capitalist process is essentially a process of change of the type which is being assumed away in this book, and all its characteristic phenomena and problems arise from the fact that it is such a process. A theory that postulates invariance of production functions may, if correct in itself, be still of some use to the theorist. But it is the theory of another world and out of all contact with modern industrial fact, unemployment included. No interpretation of modern vicissitudes, "poverty in plenty" and the rest, can be derived from it.

The central thesis that under-employment can exist in a state of stable equilibrium and that saving is responsible for it is then made to follow from two additional hypotheses. The one—embodied in the concept of Propensity to Consume—is that "when aggregate real income is increased aggregate consumption is increased, but not by so much as income" (page 27). This Mr. Keynes dignifies, in the worst style of a bygone age, into a "Psychological Law." The question of fact apart—statistics of installment selling and other forms of consumers' credit obviously suggest the possibility of doubt—such a "propensity" is again nothing but a *deus ex machina*, valueless if we do not understand the mechanism of the changing situations, in which consumers' expenditure alternatively increases and contracts, and redundant if we do. Postulating, however, an independent and systematic tendency to that effect, Mr. Keynes finds a "gap" in expenditure resulting from it which may or may not be filled by investment and tends to widen as communities grow more wealthy. This amounts to introducing another hypothesis: the hypothesis of failing "Inducement to Invest."

Since Mr. Keynes eliminates the most powerful propeller of investment, the financing of changes in production functions, the investment process in his theoretical world has hardly anything to do with the investment process in the actual world, and any proof, even if successful, that (absolutely or relatively) failing "Inducement to Invest" will produce under-employment would have no greater practical importance than a proof that motor cars cannot run in the absence of fuel. But that proof, even under its own assumptions and granting that in Mr. Keynes' world there would be a systematic tendency for Inducement to Invest to grow weaker,<sup>4</sup> meets the obvious objection that Propensity to Consume and Inducement to Invest are not independent of each other. In some passages (for example, page 30) Mr.

<sup>4</sup> To many people statement of such a tendency will sound "realistic." This is however entirely due to recent experience and would have equally been the case after, say, 1720 or 1825 or 1873. No support of the theory in question can be derived from this, since it rests exclusively on observation of the surface mechanism of a deep depression *already in progress*, the explanation of which must be worked out independently of it.

Keynes seems indeed to hold that they are. We can absolve him, however, from the grave error this would spell, because each time (for example, page 31) he in fact admits the existence of an equilibrating mechanism. But then the whole *theoretical* case, that is, the case in terms of fundamental features of the economic process, collapses, and we are *practically* left with friction, or "stickiness," institutional inhibitions, and the like, which in particular may prevent the rate of interest from reacting promptly or, in general, prevent the whole of that equilibrating mechanism from functioning adequately.

Space forbids our entering into a discussion of the Multiplier, its relation to the Propensity to Consume, the system of Wage Units, and other tools by means of which Mr. Keynes works out his basic ideas. I wish however to welcome his purely monetary theory of interest which is, as far as I can see, the first to follow upon my own. Unfortunately, I must add that the similarity stops there and that I do not think my argument open to the objections which this one is sure to meet. Some differences would vanish, if the concepts of a demand for money stocks and of "liquidity preference"—which is another *deus ex machina*; there is a whole Olympus of them—were replaced by concepts drawn from the economic processes that lie behind the surface phenomena denoted by those two. But then many of the striking inferences would also vanish. The whole vision of the capitalist process would change. Interest would lose the pivotal position which it holds in Mr. Keynes' analysis by virtue of the same technique which made it possible for Ricardo to hold that profits depend upon the price of wheat. And a completely different diagnosis of modern difficulties would follow.

The less said about the last book the better. Let him who accepts the message there expounded rewrite the history of the French *ancien régime* in some such terms as these: Louis XV was a most enlightened monarch. Feeling the necessity of stimulating expenditure he secured the services of such expert spenders as Madame de Pompadour and Madame du Barry. They went to work with unsurpassable efficiency. Full employment, a maximum of resulting output, and general well-being ought to have been the consequence. It is true that instead we find misery, shame and, at the end of it all, a stream of blood. But that was a chance coincidence.

JOSEPH A. SCHUMPETER

Harvard University

*The Economics of Inflation, The Basis of Contemporary American Monetary Policy*, by H. Parker Willis and John M. Chapman. New York: Columbia University Press. 1935. xi, 443 pp. \$4.50.

This book puts into printed form the proceedings of the Banking Seminar of the School of Business of Columbia University, apparently principally in the academic year 1933-34. Part I was prepared by Professors Willis and Chapman, in charge of the course; Part II, the contribution of the 13 student members of the seminar, is made up of various short statistical, histori-

cal and analytical studies, which to some extent provide the detailed background for Part I.

The plan of the book doubtless has certain advantages in permitting more prompt publication than if all the material had been thoroughly assimilated into one integrated whole. Moreover, for the purposes of some one who wants to make a study of the various aspects of inflation, the book as it stands might constitute a fruitful starting place because of the various points of view expressed, and because of the references, particularly in Part II, to various authorities. The disadvantages of the plan, however, are that the main ideas do not get as detailed and complete treatment as would be expected in a treatise of 430 pages of text and tables, whereas many ideas are repeated in an elementary form in a number of places. A further difficulty is that the several authors do not stick to the same definition of inflation throughout nor take the same attitude towards its various manifestations.

The rather unusual definition of inflation which Professor Willis proposes greatly affects the subsequent treatment, even though it is not adhered to throughout. His primary definition is (page 10): "an inflated or deflated condition is one in which voluntary action on the part of the State or of the community in general has established a set of economic relationships which is different from what would ordinarily have been established had it not been for such planning." It seems to the reviewer that this definition is rather far removed from accepted usage and covers so broad a possible field as to represent an undesirable innovation. Any attempt to use the definition as a criterion whether inflation had or had not occurred in a particular case would reveal that it is of practically no value because of the difficulty of deciding whether a certain action is or is not "voluntary" and whether a given set of economic relationships is or is not different from what would "ordinarily" have been established. As a matter of fact, most of the subsequent discussion modifies the definition somewhat by limiting the field in the main to voluntary action concerned with currency or credit and by looking for the principal effects of inflation in commodity, security, or real estate prices.

The supplementary essay on "Inflation in Current Economic Literature," by Anatol Murad, might well have been made more specifically the basis for the fundamental definition. After some keen criticism of the definitions of Professor Cassel and others, the following is finally worked out as a logical version of the usual view: "Inflation is the creation of purchasing power in excess of requirements for the production and consumption of goods at prevailing price levels provided there is no change in the processes of production and exchange." Although Mr. Murad expresses doubt that this definition really gets at the heart of the matter, it would seem to be more usable than the one actually adopted by Professor Willis.

The book as written, however, reflects Professor Willis' definition as quoted. He insists repeatedly that the existence or non-existence of inflation cannot be tested by the course of commodity prices; that the shift of bank

assets from commercial loans to corporate and Government bonds is inflationary; that the heart of inflation is an attempt to redistribute wealth and income; and that any economic or financial condition resulting from attempted central planning is inflationary. Perhaps because of this insistence on a broad definition of inflation and the consequent range of problems touched upon, Professor Willis' discussion frequently degenerates into dogmatic generalities. By classifying as "inflationary" all ideas of reflation, devaluation, stabilized dollar, and central planning, Professor Willis condemns them without adequate unprejudiced analysis and tries to spread over them the odium which properly attaches to the German mark type of inflation.

Another peculiarity of the treatment, in addition to this unusual method of defining inflation, which prevents the authors from really getting into the real vitals of the subject, is a failure to accept obvious historical facts as to the stimulating effect of devaluation on the dollar prices of international commodities. After listing the prices of certain commodities in November, 1932, and in November, 1933, Mr. D. J. Leahy, one of the students, says "We can recognize a distinct rise in each of the various price levels, but for the greater part we cannot suppose that the influence of exchange depreciation had more than a slight effect." Professor Willis himself says that there is no support whatever, in fact, for the claim that changes in the weight of the dollar had brought about corresponding changes in the wholesale prices of certain commodities.

In comment on these surprising statements, it is generally agreed that prices of commodities not directly affected by foreign trade showed little or no immediate change, and that the extent to which any average of commodity prices was affected by the reduction in the gold content of the dollar depends on what commodities are included in the average. But for standard raw materials like cotton, tin, and rubber, on which there were no tariffs impeding the movement between the American markets and markets still closely linked with gold, and for which the cost of transportation was a small fraction of the price, it was logically inevitable that the American dollar prices should have moved in close parallelism with the price of gold and it was, in fact, obvious to those who watched them day by day that they were so moving.

Failure to appreciate these evident facts of record is not just a minor slip but completely forestalls any possibility of analyzing correctly the effect of the gold devaluation policy, which in the case of cotton alone put the southern cotton producers back on the road to solvency. The argument as to the wisdom of the devaluation policy is of course not settled when these facts are conceded, but it is at least begun on a realistic basis.

Attention must be called to an error in elementary statistical inferences on pages 166 and 167 of Chapter IX, "The Farmer and Inflation." Professor Chapman reproduces two tables comparing index numbers for prices received for farm products and for prices paid by farmers for commodities bought, one table being stated with 1910-1914 = 100 and the other with 1923-1925 = 100. Professor Chapman says that the second table "shows that the



farmer fared better than the manufacturing group for the period 1910-1914 whereas the other data indicate that the two classes of prices were almost the same when adjusted for the full period, agriculture having a very slight disadvantage." This remarkable deduction of two different conclusions from two versions of the same set of index numbers depends on the erroneous assumption that index numbers compare absolute values rather than conditions relative to the base year. The correct statement, of course, is that the second table (or the first table) shows that prices received by the farmer in the period 1910-1914 were on the average not so far below prices received in 1923-1925 as the prices paid by farmers in 1910-1914 were below prices paid in 1923-1925.

Because of the failure to adopt and adhere to a sound definition of basic concepts, the refusal to recognize certain essential facts, and the inadequate use of statistical methods, the general treatment does not inspire confidence. A further lack of scholarly excellence is the frequent allusion to ideas supposed to be advocated by others without specific reference to direct quotation. All things considered, the book is not recommended for general use, although some of the sections in Part II, which it is obviously impossible to discuss in detail here, make real contributions toward an understanding of certain phases of the subject.

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*The Money Supply of the American Colonies before 1720*, by Curtis Putnam Nettels. Madison, Wisconsin: University of Wisconsin. 1934. xviii, 300 pp. \$2.00.

Based almost entirely on primary sources, including the colonial records in English and American archives, this monograph supersedes all previous studies of the early history of colonial currency. The product fully justifies the "seven or eight years" of labor involved in its preparation.

The difficulty of maintaining an adequate domestic supply of money (in the face of a bimetallic ratio chronically divergent from the market ratio, the drainage of specie to the East Indies, and the failure to grasp the principles governing a subsidiary coinage) and mercantilist predilection for the precious metals prevented the mother country from allowing exports of money to the colonies. In order to preserve the yield of proprietary dues, quit rents, and private indebtedness, numerous petitions to establish mints in the colonies were steadfastly denied. "Massachusetts did erect a mint in 1652, and thereby became guilty of usurping the King's prerogative. Partly for this reason she lost her charter in 1684." The chronic scarcity of coin gave rise to commodity money, which "differed from simple barter in one important respect. The various colonial assemblies enacted that certain products should be received in payment of taxes and all other public debts. These commodities were then called current money, or in some places,

country pay." At some time in one or more colonies wampum, tobacco, wheat, beef, pork, peas, Indian corn, barley, rye, flax, hemp, wool, fish, lumber, pitch, tar, cattle, dairy products, and several other articles served as a medium of exchange and a measure of value. The lack of such characteristics of good money as durability, divisibility, transportability, storability, and (above all) homogeneity and stability of value rendered these commodities unsuitable for monetary use. It was the heterogeneity rather than the bulkiness of tobacco that gave rise to the circulation of warehouse receipts. The chronic overproduction of tobacco resulting from its use as money should give pause to the advocates (if there are any left) of the Edison-Ford nostrum for monetary reform.

Most of the specie in the colonies consisted of Spanish eight-real pieces, or pieces of eight; but some English and Portuguese coins were also in circulation. The well-known competitive overvaluation of pieces of eight in the colonies reflected the lack of legislative unity in monetary affairs, mercantilist worship of the golden calf, and a scarcity of coin. Believing that this policy would attract specie and thus stimulate the development of industry and divert attention from the production of staple raw materials, England restricted the overvaluation of foreign coins by the Southern colonies from the beginning. At the instigation of the Board of Trade a royal proclamation of 1704 "declared that the standard piece of eight of seventeen and a half pennyweight should not pass in any colony at more than 6s."; but no sanctions were provided. Successful resistance to the proclamation by Massachusetts, Pennsylvania, New York, and South Carolina (the four leading commercial colonies) "forced the Board of Trade to act again." In 1708, Parliament passed an act prescribing "that any person in the colonies who, after May 1, 1709, paid or received coin in discharging debts contracted after that date should be imprisoned six months or pay a fine of £10 if the coin exchanged bore a value higher than the proclamation rate." In an effort to avoid deflation rather than to achieve additional inflation "several of the colonies evaded the new law as effectively as they had evaded the proclamation."

The earliest recorded instance of paper money issued by a government occurred in the American colonies. To pay soldiers who threatened to mutiny following an abortive attack on Canada in 1690, Massachusetts issued the first of the bills of credit which were destined to plague America until abolished by the constitution. The extensive use of private credit, the wide circulation of bills of exchange, and the issuance of tax anticipation warrants had prepared the way for the fiduciary issues. In 1703, South Carolina emitted bills of credit to defray the expenses of an expedition against Saint Augustine; and by 1715 all the colonies except Pennsylvania, Maryland, and Virginia had succumbed to the paper money contagion. At first the bills of credit were not legal tender; taxes were provided for their redemption; emergencies were either the pretexts or the causes of their issue; the quantity was moderate; and the bills circulated at or near par. Before 1720, however, the colonies made heroic efforts to force the circulation of bills of

credit at par; the taxes pledged for their redemption were extended several years into the future; canceled bills were promptly reissued; the quantity was excessive; and sharp depreciation was the inevitable consequence.

Dr. Nettels examines Adam Smith's and David Ricardo's analysis of the depreciation of colonial bills of credit and accepts Ricardo's ascription of the phenomenon to overissue. Neglect of the discussion of bills of credit by Sir James Steuart and other mercantilists presumably resulted from limitation of space, for Dr. Nettels is obviously familiar with the literature of mercantilism and colonial policy. The tireless energy displayed in the collection and analysis of data strikingly contrasts with the obvious carelessness in proofreading. Much more serious is the strong tendency toward uncritical acceptance of the contemporaneous complaints of a shortage of money. Vehement protests against an inadequate currency were rife in Spain during the Price Revolution of the sixteenth century, in America during the Civil War, and even in Germany under hyper-inflation. The most serious deficiency is the failure to examine the alleged dearth of coin in the light of the Ricardian specie-flow mechanism. Had specie been as scarce as Dr. Nettels seems to believe, why would not prices have fallen sufficiently below the world level to induce an influx of specie into the colonies? May not commodity money and paper currency have been causes rather than consequences of a scarcity of coin? One must admit, however, the possibility that such factors as imperfect markets, colonial exclusionism, and the lack of transportation facilities obstructed the normal "pull" of prices on specie.

Dr. Nettels has not only written an excellent monograph on "The Money Supply of the Colonies" but also provided (largely from documentary sources) a wealth of information concerning commerce between England and the Spanish American colonies; intercolonial trade; the economic relations of Boston, New York, and Philadelphia; British colonial policy; piracy; industrial and agricultural development of the different regions; trade between England and the colonies; and the economic philosophy of the period. This is one of the greatest contributions to American economic history in recent years.

EARL J. HAMILTON

Duke University

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*Money, Prices, and Wages in Valencia, Aragon, and Navarre, 1351-1500*, by Earl J. Hamilton. Harvard Economic Studies, Volume LI. Cambridge, Massachusetts: Harvard University Press. 1936. 310 pages. \$4.50.

Two years ago, Hamilton presented an analysis of the price revolution in Spain from 1501 to 1650.<sup>1</sup> That study showed that following the discovery of precious metals in the new world commodity prices rose six times and that this rise was about in proportion to the imports of precious metals.

The second volume of Hamilton's work covers prices, wages, and money

<sup>1</sup> Hamilton, E. J., *American Treasurer and the Price Revolution*, Harvard Economic Studies, Volume XLIII, 1934.

in North Eastern Spain during the century and one half prior to the discovery of America (1351 to 1500).

The first two-thirds of the book, containing thirty tables and twenty-one charts, is divided into three parts dealing with Valencia, Aragon, and Navarre. The most valuable material was found in Navarre. Each part is subdivided into three sections dealing with money, wages, and prices. The last third of the book, the appendix, gives detailed statistics of coinage, prices, and wages.

The study was based on an analysis of public, private, and ecclesiastical documents in many parts of Spain. Differences in weights and measures, arising from the same or different names or the same or different quantities, plus the confusion of coins of variable weight, made Hamilton's job a most difficult one. The book contains copious footnotes of sources. The author was not given to indiscriminate generalization and frequently warns the reader of the limitations of the data.

Hamilton's evidence would indicate that from 1351 to 1380 prices in terms of gold rose because of increasing supplies of gold discovered in Silesia and Hungary. From 1381 to 1425-45, the level of prices in fixed weights of precious metals was generally downward. Valencia and Aragon, which did not participate in the flagrant inflation that occurred in many countries, debased their coins moderately but not sufficiently to prevent a fall in commodity prices in terms of the money of account. In Navarre, the debasement was more severe, and commodity prices in money of account rose 3.0 per cent per year.

In 1346, Valencia adopted the gold standard despite the vigorous protests made to the King. In Aragon, gold prices moved more violently than the prices in the money of account.

In Valencia and Aragon, real wages were comparatively stable. In Navarre, nominal wages rose more than prices, but real wages lagged in the advance.

Hamilton was fortunate in that he could study the time lost in the building trade on account of holidays. Excluding Sundays, religious holidays were 38 per year, which was quite similar to the national and religious holidays in France.

There appeared to be a striking rigidity in craft division. Journeymen received wages about 39 per cent above the helpers. Earnings of stone cutters were 122 per cent of the earnings of carpenters' helpers; plaster helpers, 106; roof tilers' helpers, 105; adobe mason helpers, 99; mason helpers, 95; apple pickers, 90; and hoe hands, 80. Wages of women were about half those of men. Bull fighters' wages were 10 per cent more than carpenters'. Hired assassins generally received more than carpenters' wages.

Hamilton concludes that the rise of capitalism in Spain did not start until the discovery of America and the subsequent price revolution that accompanied the huge imports of precious metals into Spain.

The monetary theorist, hard or soft, will find food for thought; the chapters on wages will be of interest to the student of labor problems; and

the economic historian and that small but increasing number of scientists interested in index numbers and prices should read the book from cover to cover.

In the third volume, Hamilton will present an analysis of the secular trends and cyclical movements of prices.

F. A. PEARSON

Cornell University

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*Past and Present Facts about Money in the United States*, by Paul Bakewell, Jr. New York: Macmillan Company. 1936. xvi, 221 pp. \$2.00.

The author of this volume is a member of the bar and a former Professor in the St. Louis University School of Law. In his preface he discloses his reasons for writing this book. It is because he has found no single book which stated accurately the history of money in the United States. "Some books, which have been generally accepted as authorities," he says, "contain statements which are contrary to fact." He is not interested in the economists' view of money, nor in banking, credit, or price theory, but simply in money as "a creature of statute" and of court decisions. In his pursuit of "facts" Mr. Bakewell says: "I found the facts to be so contrary to certain ideas which have been generally accepted that I support each and every statement of fact by reference to a specific statute or to a court decision."

Part I of this book deals with monetary history up to 1933; Part II with changes since 1933. The first part seems to have no "facts" not found in basic texts. It does have some peculiar interpretations and novel definitions. Part II cites statutes and court decisions dealing with gold devaluation and silver.

On page 38 he says that "unthinking people" sometimes demand "cheap money" as a remedy for adverse economic conditions. But he explains: "money is valuable because it is dear: if it becomes cheap it loses value."

He also gets the reader confused by his peculiar contention that Congress can regulate the value of money but not the standard of value. In commenting upon recent legislation which changed the statutory price of gold, the author says the statute "does not make sense." But just why it does not make sense to change the price of gold from \$20.67 to \$35.00 an ounce is not explained. The author argues that "a statute which says that currency of a specified face amount is the equivalent of one amount of gold today, but of an entirely different amount of gold tomorrow, sounds like the talk of a mystic or prestidigitator." Mr. Bakewell is evidently unfamiliar with the free gold market in which the price of gold may fluctuate from minute to minute.

He cannot understand how Congress can change the "standard" of value. This is impossible, the author proves, by quoting the dictionary, that a standard is a "fixed" unit. And, he argues, a fixed unit can not be fixed if it is changed. The author seems to forget that the unit can be fixed at different values at different times and that few things are fixed for all time. Chapter

XXXII deals with this great difficulty. The author insists that once Congress has established a standard unit of value it does not have power to change it. Because if it can be changed it cannot be fixed forever. Ergo, the power to "fix" precludes the power to change. After reviewing the recent court decisions approving recent monetary changes the author still contends that the Supreme Court has not yet answered the question: "Can something that is fixed be changed?"

By his verbal juggling the author has thus created a dilemma for himself and for his readers. He has added no words of enlightenment and will leave confused and bewildered anyone not already fortified by familiarity with the theory of money and banking. His "facts" are mostly peculiar interpretations of his own and a mass of confused thinking. This book adds nothing to the subject, is of no value to the trained reader, and will simply muddle up and misinform the general reader.

W. A. MORTON

University of Wisconsin

*The Downfall of the Gold Standard*, by Gustav Cassel. Oxford: Oxford University Press. 1936. viii, 262 pp. \$2.25.

Professor Cassel describes the actual working of the gold standard and emphasizes how different this has been from the theoretical. He gives an interesting account of the numerous international monetary conferences since the War. Since he has been a member of nearly all of these, the book contributes much to the trend of thought that is not given in the official reports.

The international gold standard is by no means such an old and venerable institution as most people seem to believe.

He spent many years working for the reestablishment of the gold standard and on numerous occasions warned of acts endangering its success. It is, therefore, interesting to note his conclusions that the defects are insurmountable.

The lesson of all this is that the international gold-standard system is a very dangerous mechanism.

Gold has failed, both as a means of payment and as a standard of value.

Proposals for the reestablishment of the gold standard nearly always include a statement that somehow the value of gold is to be controlled. This implies the use of some other standard to which gold is to be made to comply.

The programmes for a restoration of the gold standard are often coupled with recommendations for a policy aiming at stabilizing the value of gold itself. Such recommendations can have a logical sense only if some other measure of value is taken as a standard. Moreover, some restoration programmes regard a

more or less violent change in the value of gold in relation to commodities as a reason for adjusting existing gold parities. This means, however, that gold is actually dethroned from its position as a standard, and that we have to agree on some other standard of monetary stability.

Provisional stabilization seems to be a rather dubious proposal. Its very essence is a rejection of gold as a standard. Another standard must be set up by which the expediency of an eventual change of the gold parity should be judged. Such a standard is, for example, that of the British monetary programme at the London Conference, viz. after a preliminary rise of the general price-level, a stabilization of that price-level. If this objective cannot be attained on the basis of a given gold parity, the gold parity has to be changed.

Having realized that gold is a very unsatisfactory standard of value we have to find an essentially broader basis for monetary stability. Then, instead of fixing the price of one single commodity, as we do in the gold-standard system, we turn to an approximate fixing of the aggregate price of a great number of important commodities, or, what amounts to the same thing, we choose an index for the general level of commodity prices and decide to regard the invariability of this index as our standard of monetary stability.

When Sweden left the gold standard it was important that some other standard should be set up for the regulation of the Swedish currency. On being asked for my counsel I insisted upon a definite declaration to the effect that the maintenance of the internal purchasing-power of the Swedish krone as against commodities was the aim of Sweden's monetary policy. The natural fear that the abandonment of the gold standard would mean leaving the currency to the mercies of uncontrolled inflation could only be met by a declaration fixing a new standard for the regulation of the currency by the central bank. The decisions arrived at were in accordance with this view.

He calls attention to the opposite view and discusses how untenable it is.

On the other hand, opinions differ even as to the desirability of maintaining the general level of wholesale prices constant. Some authors propose that this level should be lowered in the same proportion as technical progress reduces 'costs of production.'

The above inquiry has disclosed the serious dangers connected with a return to gold as a basis of our monetary system. The main consequences that we have to fear from such a backward step are: in the immediate future, an exaggerated rise in prices based on the superabundance of revalued gold reserves; later on, a new shortage of gold with a repetition of the deflation and the depression that we have just gone through; generally, we would have to reckon with a periodically recurrent aggravation of economic crises resulting from that competition for gold and that enhancement of its value which would always follow extraordinary endeavours to secure liquidity; further, the whole series of disturbances connected with the very controversial question of an equitable redistribution of the world's gold reserves and of the use to be made of these reserves for the supply of means of payment; not to speak of the perturbations that would follow if countries again began to accumulate disproportionate gold reserves; the general strengthening of protectionism throughout the world that always ac-

companies an acute international competition for gold; and finally, the constant presence of that element of insecurity which is instilled into economic life by the fear lest existing gold parities might again be abandoned.

G. F. WARREN

Cornell University

*Gold and Prices*, by George F. Warren and Frank A. Pearson. New York: John Wiley & Sons, Inc. 1935. vii, 475 pp. \$5.00.

What began as a book on agricultural prices several years ago has by now turned out to be an ambitious history of all prices, as well as a text on monetary theory. *Prices*, published early in 1933, has been brought up to date by the addition of statistical material for the year 1934. Five new chapters elaborate the authors' well-known theory of money.

A brief summary of their views may be helpful as a key to the contents of this most discursive book. The production of gold, they hold, is very irregular; it has little immediate relation to the demand for it; the result has been the erratic price levels of the past seventy-five years. The periodic deflations which have characterized the history of prices over this period have become so telling in their effects as no longer to be tolerable. The authors recommend "some form of an all-commodity, or many commodity, dollar" (p. 295). Mere revaluation of the currency unit by a reduction in its gold content is no short cut to monetary stability, but rather a drastic expedient justified by the desperate situation faced by the Government in 1933.

More specifically, the old gold standard is looked upon as impracticable for the following reasons: (1) the proliferation of commodities and services under large-scale production, the lessening of individual and local self-sufficiency, have made for a rise in the number of transactions which is disproportionately large by comparison with the secular trend of business. The supply of gold available for monetary use has not been adequate for this ever expanding demand. To the stock answer to this contention: improvements in the efficiency of the modern banking process make a given amount of gold more effective in the monetary use, Warren and Pearson reply that there is no evidence to show that an ounce of gold would finance more transactions per year in 1929 than in 1900. (2) The woes of the debtor and taxpayer during a period of deflation are thoroughly aired as an argument against the fixed gold standard. (3) The argument for deflation as a necessary and wholesome process is looked upon as fatuous, in the light of the many "administered" prices, inflexible public utility rates, taxes, union wage rates, salaries, and handling charges. (4) Stability of wage payments is regarded unfavorably because the 1.7 per cent average annual rise in the productivity of labor should be reflected in higher wage rates. Thus, stable commodity prices and slowly rising wage rates would go together. "If total wages are stable, the only way to promote the highly efficient worker is by



lowering the inefficient worker. This is difficult to do. Therefore, the efficient worker is likely to fail to be promoted and incentive is lost" (p. 273).

Although the monetary theory of the authors gives a kind of unity to this work, the topics treated are so numerous and diverse as to defy classification. The principal subjects, however, are: the history of the prices of raw materials during the past century; the fluctuations in the production and value of gold since the discovery of America; the effects of the discovery of America on prices; detailed tables and charts dealing with the price history of wheat, corn, and other agricultural commodities; the price fluctuations in the three major crises since the Civil War; a short study of farm land and urban real estate values and building activity; taxes as related to farmers' incomes at the several price levels; purchasing power of wages since 1840 in the United States, including informative tables of the variations in the salaries of Government employes, school teachers, and college professors in periods of inflation and deflation; contrast of farm and city wage rates.

Most of these topics are treated in a sort of hit-and-run style. This method may leave the reader unsatisfied, but it has the virtue of permitting the authors to range widely. The net effect is stimulating.

The book should prove useful to university instructors as a compendium of illustrative reference materials. Besides, it is an inductive approach to the study of money. The innumerable illustrations of the operation of monetary forces, many homely and familiar, as the variation in the number of marriages in Saint Louis with the phases of the business cycle, must make *Gold and Prices* more interesting and readable for the novice than the conventional studies of money.

It is unfortunate that Professors Warren and Pearson did not develop their chapters on stabilizing prices and the price outlook further. They seem not to think it worth mentioning that every currency is managed. The modernized gold standard proposed to Congress by Mr. Warburg is nothing but a device for a paper currency loosely tied to a gold reserve, but everywhere under the management of the bankers.

GEORGE K. McCABE

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Washington D. C.

*State Bank Failures in Michigan*, by Robert G. Rodkey. Ann Arbor, Michigan: University of Michigan, Bureau of Business Research. Michigan Business Studies. Vol. VII, No. 2. 1935. 69 pp. \$1.00.

The principal subject for investigation in this study is the 163 Michigan state banks which failed between January 1, 1930, and February 11, 1933. With one exception, these banks were located outside Detroit. During the same period 411 other state banks remained open. The author was given access to the regular call reports and to the examiner's reports made to the Michigan State Banking Department by each of the 163 state banks which

failed during the period chosen. The reports were utilized to give summary data appropriate for the analysis of the conditions of failure. Although this special information was scarcely broader than that published for national banks in the country as a whole, it does indicate a commendable effort on the part of the author to improve the basic facts at hand for the diagnosis of the causes of failure of the Michigan state banks. Failures were related to size of city, size of bank, ratio of invested capital to gross deposits, liquidity measured by selected items, investment in real estate mortgages, diversification of assets, and profits and losses of the banks.

It is ironical that the study covers only one defunct Detroit bank; all others escaped inclusion because they were national banks, they were taken over by other banks, or they were supported until the time of the Michigan bank holidays. Nevertheless Detroit will long be remembered as the major storm center—especially, no doubt, by the officials of the Reconstruction Finance Corporation.

Much of the author's analysis is built around a comparison of the failed Michigan state banks outside Detroit with all national banks or all country national banks in the United States as a whole. At times, of course, no other comparison is possible, but surely when data for solvent Michigan state banks outside Detroit are obtainable they should be given preference over the data for all national banks, many of which failed during the period. When it was found, for example, that the ratio of capital investment to gross deposits of failed state banks outside Detroit was practically as favorable as that of solvent state banks outside Detroit the emphasis was shifted to a comparison with all national banks in the country (pp. 114 and 115). One should observe that the solvent Michigan state banks outside Detroit had a smaller ratio of capital funds to gross deposits than all national banks in the country as a whole (10.96 per cent against 14.78 per cent), even though part of the national banks failed. Results of this nature cannot be reconciled with the author's presumption that a difference of three or four points in the percentage of capital funds to deposits is a matter of consequence in maintaining solvency. Perhaps this negative evidence should lead to a modification of the time-honored view that a small percentage alteration of capital funds results in appreciable change in the strength of banks. How much added support does a four-point increase in the percentage of capital funds to deposits provide in the face of a 50 per cent liquidation of deposits? A few assets eligible for rediscount with the Federal reserve bank may be more important. In making the hybrid state-national bank comparison, it should be observed that all national banks were members of the Federal Reserve System; most state banks were not members.

The ratio of real estate mortgages to savings deposits is not a good measure of lack of liquidity even though one concedes that the mortgages become frozen easily. Banks fail as units. Both savings and demand deposits are involved, and demand deposits are the more variable of the two items. Using the ratio of real estate mortgages to savings deposits as a criterion, the author finds that failed state banks were more liquid than solvent state

banks (p. 123). A comparison of the mortgages with gross deposits, however, would have given opposite results.

The author's liquidity measure relates mostly to United States Government obligations (p. 119). He recognizes that open-market commercial paper, bankers' acceptances, call loans, and possibly customers' loans eligible for rediscount might be included if the data permitted. The failed Michigan state banks were definitely less liquid than national banks in the sense that they held fewer Federal issues. No mention is made of the practice of the Treasury of favoring national banks in the marketing of its obligations. Furthermore, is the measure as it stands shorn of other liquid items of much significance? Would banks be fully liquid if they were to become little more than Government bond trusts? Were the banks non-liquid before the War when there were almost no Federal obligations for them to hold? Will they be forced to become non-liquid when (no date will be set!) the Federal Government is able to reduce its debt to a nominal figure? The holder of Government obligations of anything more than short-term maturity must take his chances on the market. When the banking crisis was at its height many of the Federal issues were selling in the 80's. Liquidity of these premier securities was therefore far from perfect for those state banks which could not use them as a basis for rediscount.

Another criticism may be directed to a tenacious dependence on a small number of cases in some classes or groups of classes of banks. When a change in less than a half-dozen cases is sufficient completely to reverse interpretations, there is a strong likelihood that either pure chance or arbitrary control may condition the results. Apart from the question whether it is socially desirable to have banks small, middling, or large, it should be noted that the mortality rates for different sized banks have different meanings when interpreted in terms of the basic soundness of the institutions. The figures undoubtedly contain biases. The author's statement that "the experience of Michigan state banks during the depression supports the widespread belief that small banks are more vulnerable than their larger competitors" (pp. 111 and 112) is open to serious question. When the Michigan state banks were arrayed in terms of total resources there was a progressive reduction in the mortality rates with increases in size, it is true, but the banks in the highest class were by no means of a universally hardy variety, and failures among the medium-sized banks were nearly as frequent as those among the smaller banks. In terms of capital funds the smallest banks fared better than the average. Banks with capital and surplus of \$25,000 or less had a better record than those of any other group except the banks with capital and surplus of \$100,001 to \$250,000 and \$500,001 and over. Moreover, an addition of only three failures to the highest group would have given it an unfavorable comparison. Was it the condition of the small, medium-sized, or large banks in Michigan which induced the Governor to become exceedingly commemorative after Lincoln's birthday in 1933?

In view of the lack of positive evidence, the most that can be said is that until there is some way of knowing the effect of the varying availability of central reserve credit, the relation of the psychology of runs to the size of

the bank when there was no Federal deposit guarantee, the pressure exerted in the time of stress to save those banks whose failure would have completely shattered public confidence, and the incidence of mergers in saving banks on the brink the author has no safe basis for assuming that Michigan state banks of any particular size should bear more of the blame than those of any other size.

WILBERT G. FRITZ

University of Pittsburgh

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*Financing Security Trading*, by William M. Blaisdell. Philadelphia, Pennsylvania. Published by the Author. 1936. 199 pp.

This book contains a series of statistical and analytical studies of the financing of stock market trading in New York, London, Paris, and Berlin. The author seeks particularly to evolve a number of statistical indices that would measure both the volume and the velocity of turnover of funds required to finance the exchange of securities on these major financial markets. Considering the paucity of data, particularly on the European exchanges, his results are creditable. Several lines of investigation attempted, such as the computation of an index of the "floating supply" of securities on the New York Stock Exchange, are pioneer efforts.

The statistical problems involved in a study of the use of funds in security trading are given more adequate treatment than the theoretical background, which tends to be fragmentary and obscure. The author refrains from passing judgment upon the regulation of security loans provided by the Securities Exchange Act of 1934 and the Banking Act of 1933 but does find that "from the point of view of the banking system, the powers given to the Federal Reserve Board and the Securities and Exchange Commission should certainly be sufficient to acquire all the statistical information necessary."

The theory of the effects upon the outstanding volume and velocity of turnover of outstanding bank credit of security market conditions must be clearly formulated before it is feasible to determine the character of statistical data needed for intelligent study and regulation of the capital market. Mr. Blaisdell's book does not develop sufficiently such a background. The theoretical discussions suffer also from a lack of clarity in definition of such fundamental concepts as "savings" and "deposit turnover," which are of first-rate importance in any analysis of the use of credit in the security markets.

JULES I. BOGEN

The Journal of Commerce  
New York City

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*Iron and Steel Companies in Years of Prosperity and Depression*, by Herman Hollis Chapman. Tuscaloosa, Alabama: Author. 1935. xx, 316 pp. including 47 pages of appendix.

This work represents an approved thesis for the doctor's degree in Columbia University. No theory of the business cycle is presented here. Instead

Dr. Chapman studies the business cycle inductively by making a detailed analysis of the financial statements of the large iron and steel companies to ascertain how this industry, in its accounts, reacts to business fluctuations. As an accountant, he frankly admits the difficulty of making valid comparisons among statements of a given concern over a period of years as well as the lack of comparability of reports among different companies. The study covers the major cycle of 1914-1921 and that portion of the present cycle which falls before 1931.

The computations of the familiar financial ratios are made for a total of thirty-eight companies covering from 60 to 85 per cent of the industry's capacity. These are brought together into a representative figure for the industry by aggregating the figures for all the companies and then computing the percentage ratio. This method gives weight to the variations in accordance with the size of the concern. The arithmetic averages of percentage ratios, which give greater weight to the variation of individual concerns, are also computed in a number of cases. These computations are placed in an appendix for those who wish to follow a line of analysis free from the smothering effect of a few large corporations in the aggregative method. Because of the dominating position of the United States Steel Corporation, its ratios are often computed separately and compared with the results obtained from the records of the other companies. Either of these procedures leads to easy generalizations, and it must not be lost sight of that many diverse and conflicting tendencies are often hidden.

Important items in the financial statements, such as current assets, cash, receivables, inventory, current liabilities, marketable securities, fixed assets, common stock, preferred stock, funded debt, surplus, reserves, sales, gross and net profit, depreciation, dividend disbursements, reinvested earnings, and interest charges, are analyzed separately and in comparison with each other. It was found that the following major trends existed throughout the period: (1) continuous expansion of productive capacity represented by increases in fixed assets, in proprietorship, and in investment in securities; (2) the building up of a vast capital fund by corporate saving, which had the double effect of increasing assets and reducing debt; (3) the concentration of production within a smaller number of companies exclusive of the United States Steel Corporation, whose relative position declined. An analysis of sales, costs, production, and profits shows that in the steel industry "the peak was reached after a sharp and continuous rise in 1915 and 1916 and the descent was accomplished more slowly and after an interruption in 1920. The second [cycle] had a more prolonged rise which was temporarily halted by the minor recessions of 1924 and 1927, and the descent in 1930 and 1931 was sharp and continuous." The industry reached a much higher peak of prosperity during the rising prices of the War period than was reached in the years 1923-1929 despite the greater volume of production in the later period. The price level for steel products declined much more rapidly in the post-War period than did general commodity prices or wages.

The author finds that a series of indices—total current assets, current

liabilities, sales, and profits—distinctly reflect both major and minor business fluctuations, whereas others—inventories, interest and dividend payments—reflect only the major cycles. Some indices—the turnover of inventories into sales or the current ratio—anticipate basic changes in the cycle, whereas others—depreciation and dividends—show a definite lag. It is interesting to note that over the seventeen-year period ending with 1931 the average percentage of change—increases and decreases—in the aggregate value of the sales and of the aggregate amount of net profits was relatively less for the United States Steel Corporation than for the remainder of the industry.

In evaluating the work the reviewer finds it to be an excellent pioneering study of a single industry to see what light it can throw upon cyclical variations. Before we can go far in this line of financial analysis, however, accountancy must become standardized. The book is marred by some repetition and could be improved by the insertion of some graphs to illustrate the statistics. It is questioned whether the statistical deflation of the index of the dollar volume of profits by a wholesale price index leads to any usable results in comparing the relative prosperity of one period with another.

PAUL L. HOWELL

Cambridge, Massachusetts

*Labor in Colonial New York, 1664-1776*, by Samuel McKee, Jr. New York: Columbia University Press. 1935. 193 pp. \$3.00.

This pleasant volume considers successively free labor, apprenticeship, indentured servitude, and slavery. It is based upon extensive and ingenious inquiry in original sources and is composed with an excellent gift of condensation. The subject is made realistic by constant brief quotations from advertisements, correspondence, courts decisions, and contemporary historians and chroniclers.

The author portrays the gradual dilution of indentured servitude and slavery in favor of free labor. The story shows, more than anything else, the importunate demand of a new and rich region for workers. At the same time, there was not always enough work for the skilled immigrants that came to the colony, so that these complained of the number of Negro slaves who were taught trades.

Many will find the treatment of slavery the chief contribution of the study. The proportion of slaves was of course smaller than in more southerly colonies, but, despite this, they were treated with suspicion generally and with shocking cruelty when there was any hint among them of plotting or rebellion. Dr. McKee is probably correct in feeling that one reason for suspicion was the readier assimilation of the imported Negroes in the staple agricultural system of the tobacco, rice, and cotton districts where the whole economy rested upon their labor. Also, the legal oppressions of the Negro slaves in New York were as much due to the fears of the whites, as to the bewilderment and recalcitrance of the blacks.

In a good many places the reader wishes that Dr. McKee had been able to sharpen the picture. He says several times that slave labor was more costly than that of freemen. One would like to have careful comparison of wages with maintenance, and some notion of the relative productivity of the types of workers. Also, the author's range of vision is not always wide enough. There might be more references to the sorts of labor treated in other colonies. Sometimes the European background of masters and servants is too summarily stated. Occasionally the text takes on the character of a page of classified want ads; this, in itself, is attractive, but want ads are in their very nature laconic and bring up more questions than they answer. Dr. McKee's material relates more to New York City, Albany, and a few other towns and settlements than to the farming districts of the colony. Although this fact makes the treatment unbalanced, the information about indentured servitude and slavery in towns is welcome because other authors have frequently neglected this important side of the question.

The book gives promise of more good work in economic history by this author. The reviewer wants to commend the total lack of pedantry and the admirable simplicity and clearness which mark Dr. McKee's presentation.

BROADUS MITCHELL

Johns Hopkins University

*Forest Taxation in the United States*, by Fred Rogers Fairchild and Associates. Washington, D. C.: United States Department of Agriculture. Miscellaneous Publication No. 218. October, 1935. 681 pp. 75 cents.

This is the final report of the Forest Taxation Inquiry, established in 1926, the impressive results of ten years of study and research by many experts in taxation and in forestry, under the direction of Professor Fairchild, pioneer investigator and outstanding authority on forest taxation. In its accuracy and completeness, its scholarly analyses and judicious weighing of various factors in the problem, this report sets a very high standard indeed; and it should not only serve to guide state and national policies with respect to forest taxation, but should stand as an example of the care, patience and unhurried deliberation which should be more common in economic research.

This report covers not only the specific subject of forest taxation but the entire fiscal system of national, state and local governments; and the problem of forest taxation is discussed in its relation to other taxes and fiscal needs. The general property tax, as usual in treatises on taxation, receives much attention and the customary criticism. The report emphasizes the fact that while taxes on forest lands are not always seriously burdensome, and are not the only or even the chief reason for timber cutting and failure to reforest cut-over lands, yet forest lands, particularly cut-over and young forest lands, are often unfairly burdened because they yield a deferred return; and timber owners must pay taxes for many years during which they have no income. Several tax schemes, modifications of the general property

tax, are suggested to relieve forest lands of their unfair burden: the adjusted property tax, the deferred timber tax, and the differential timber tax.

A reading of this report, excellent as it is, stirs in the reviewer no strong hope of an early solution of our forest problem. When our enterprising forefathers turned forest lands over to private ownership they left for us a nearly insoluble problem. Even if legislators had the patience and training to read such a report as this, and to draw up tax laws in accordance with its recommendations, modification of the tax laws would not solve the problem. The solution, if there ever is any, will probably have to be found in vastly enlarged Federal and state forests.

JOHN ISE

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*Vacations with Pay for Wage Earners.* (N.I.C.B. Studies No. 215.) 1935. 35 pp. \$1.00.

*Wanted: Skilled Labor.* (N.I.C.B. Studies No. 216.) 1935. 37 pp. \$1.00.

*Financial Incentives—A Study of Methods for Stimulating Achievement in Industry.* (N.I.C.B. Studies No. 217.) 1935. ix, 47 pp. \$1.50.

*Women Workers and Labor Supply.* (N.I.C.B. Studies No. 220.) 1936. xi, 42 pp. \$1.00.

*What Employers Are Doing for Employees—A Survey of Voluntary Activities for Improvement of Working Conditions in American Business Concerns.* (N.I.C.B. Studies No. 221.) 1936. xiv, 70 pp. \$2.00. New York: National Industrial Conference Board

Of the five related studies issued by the National Industrial Conference Board between April, 1935, and March, 1936, three are of interest chiefly to personnel and industrial managers, and the other two are of significance to any who are concerned, whether as statisticians or employers, with our labor supply.

The first, third, and fifth deal with vacations, financial incentives, and a comprehensive survey of personnel activities; the two of more general interest, with the dearth of skilled labor in the metal manufacturing industries and with women workers.

The monograph dealing with vacations traces the destiny of most of the 281 plans for wage earners that were known to exist in 1931 and of a baker's dozen started since 1932. Half operated continuously throughout the depression (assuming it now to be at an end), and another 10 per cent were discontinued but later reinstated. Over a third were discontinued—a fact not to be wondered at when one considers that vacations with pay cost about as much as all the other personnel activities combined. The relative scarcity of these plans for hourly workers is likewise traceable to their expensiveness.

The study of financial incentives indicates that the same percentage of



some 700,000 wage earners (44 per cent) were paid on some incentive basis in 1935 as in 1924. The significant change has not been toward or away from incentives, as has been thought by superficial observers, but in the drift from piece work to one of the premium and bonus systems. Doubtless, an important reason has been the sales effort of certain firms of management consultants. The weakest part of this report is that dealing with employee attitudes. Obviously, these cannot be accurately obtained through reports from employers.

Study No. 221 is perhaps the most comprehensive of the studies made to date of the "voluntary" activities undertaken by employers for their employees. The sample includes 2,452 companies and 4.5 million employees, of whom over half are in companies employing more than 10,000 workers. As Dr. Virgil Jordan points out in his foreword, this survey brings out the accomplishments of American enterprise that tend to be overshadowed, at least in the amount of news space, by the activities of government. For students of industrial relations, this is a very worth-while volume that is all the more useful because of its brevity.

The report dealing with skilled metal workers is less satisfying than the others, at least with respect to its statistical evidence. It estimates a 25 per cent reduction in highly-skilled labor since the onset of depression and reports a lack of skilled toolmakers and others by 35 per cent of the companies reporting.

The analysis of the relation of women workers to our labor supply is an an interesting and effective answer to the questions one hears discussed endlessly concerning unemployment. It shows what, of course, anyone could have found from the Census data, that there were more workers per million of population, 10 years of age and over, in 1930 than in 1880 (495,000 vs. 473,000 to be exact). But during this period, the number of men gainfully employed per million inhabitants declined 15,000; the gain in the total came from the influx of women, chiefly into the distribution and service industries. In fact, the number of women in gainful occupations quadrupled in comparison with a population increase of 145 per cent.

This gain in the percentage of population gainfully employed is attributed both to shorter hours and to the diversification of human activities associated with a higher standard of living. The second of these reasons is supported by the percentage distribution of workers in production and in distribution and service industries. The percentage in production declined between 1880 and 1930 from 75 per cent to about 53 per cent, whereas the proportion in distribution and service industries rose from 25 per cent to 47 per cent. The study concludes that there is little evidence of women having encroached upon male occupations. Rather, it attributes the increase to the inability of the male population to meet the increased demand for labor resulting from the development of services. The report also summarizes the state figures on the unemployment of men and women between 1929 and 1935. Women suffered less severely than men, and the report observes that the service occupations in which women predominate declined less and at a

later date than the productive industries. It concludes that the employment of women has not injured the male population.

Although one may agree that this is an answer to the silly talk of a few years ago concerning the firing of married women, it still does not get to the bottom of the social problem involved. Though no one quarrels with the gainful employment of married women who have others really dependent upon them, there must often be a social loss when the wife runs an office instead of her home. Her money contribution to the family exchequer is at least partially offset by her lessened ability to make the most of her job of family spender and manager.

C. CANBY BALDERSTON

University of Pennsylvania

*Wheat Studies of the Food Research Institute* (Stanford University).

"Japanese Self-Sufficiency in Wheat," Vol. XII, No. 3, November 1935, pp. 57 to 100. \$.75.

"The World Wheat Situation, 1934-35, A Review of the Crop Year," Vol. XII, No. 4, December 1935, pp. 101 to 182. \$1.00.

"World Wheat Survey and Outlook January 1936," Vol. XII, No. 5, January 1936, pp. 183 to 220. \$.50.

"The Stale-Bread Problem," Vol. XII, No. 6, February 1936, pp. 221 to 247. \$.50.

"Canadian Wheat Stabilization Operations, 1929-35," Vol. XII, No. 7, March 1936, pp. 249 to 271. \$.50.

"New Data on United States Flour Production Since 1899, By States and by Sizes of Mills," Vol. XII, No. 8, April 1936, pp. 273 to 312. \$.75.

"World Wheat Survey and Outlook May 1936," Vol. XII, No. 9, May 1936, pp. 313 to 338. \$.50.

"World Wheat Utilization Since 1885-86," Vol. XII, No. 10, June 1936, pp. 339 to 404. \$1.00.

In one sense, these eight monographs cannot be reviewed as a single study. They deal with quite different aspects of the many problems associated with world wheat production and consumption. In another sense, however, they support each other and do form parts of a complete study. It must be kept in mind, however, that they are but eight chapters in a long series and are not arranged in any logical order as would be the case in a finished book.

Three of these monographs deal with the world wheat situation from 1934 to the spring of 1936 (Numbers 4, 5, and 9). It is pointed out that during the 1934-1935 season world wheat stocks were reduced from a record peak in the midsummer of 1934 and reached halfway towards normal levels by

August, 1935. A considerable part of the carry-over remaining at that time was held in Canada as a result of price-supporting operations there. International trade in wheat during 1934-1935 was at its lowest level since the War. Exports from the United States particularly were curtailed; in fact, the United States was a net importer for the first time since 1836-1837.

It was pointed out that another short world crop in 1935 suggests still further reduction in carry-over. Since these studies were issued, crop conditions in North America in 1936 have proven to be bad, and, as a result, the winter of 1936-1937 will probably show a very important reduction in stocks in all countries. No basic solution of the wheat surplus problem seems to have been found, however. Wheat consumption for food remains low, and growers seem still prepared to produce more than world markets will absorb at prices that are satisfactory to the growers.

Perhaps the prolonged drouth of 1936 may result in a semipermanent reduction of wheat acreage in certain parts of North America. At least, the drouth situation, coupled with the continued likelihood of surplus production, raises some very important questions in social policy.

It is pointed out in Bulletin Number 5 that one of the principal factors in the world wheat situation is the control of Canadian wheat supplies exercised by the Canadian Wheat Board. Bulletin Number 7 is devoted to an analysis of the Canadian wheat stabilization operations during the period 1929 to 1935, inclusive. This bulletin is introduced by a comparison of American and Canadian developments with special reference to the activities of the Federal Farm Board and the Farmers' National Grain Corporation in the United States. It is pointed out that these organizations as well as the Canadian organizations are experiments in marketing on a very large scale. They should furnish some answer to certain basic questions. Among these questions are the following:

1. Can a market operator, financially strong, bend the price at will and make it turn in the direction he wishes it to take?
2. Can such an operator negatively block or divert any major trend of prices resulting from the play of regular market forces?
3. To what extent and under what conditions can he either positively or negatively influence price fluctuations and temporary movements?

Unfortunately, there is no practicable way to develop final answers to these questions. The factual material regarding wheat pool purchases, sales, and holdings, and regarding both Winnipeg and Liverpool prices, is presented both tabularly and graphically. Their apparent implication is discussed in some detail. The general conclusion is suggested that the experience of both the Federal Farm Board and the agency in Canada answers the first two questions definitely in the negative. Even in the case of the third question, it was found that the immediate reactions of price to the impact of buying and selling by the Canadian agency were surprisingly few. In other words, the tentative conclusion of this study is to the effect that large-scale governmental operations of the sort undertaken in the United States and

Canada can have no far-reaching effect on quantity-price relations. One appears to be forced back to the conclusion that, when prices are below those considered remunerative by the producer, the only relief lies in a reduction of the quantity produced.

As other illustrations of world developments in wheat production, Bulletin Number 3 deals with Japanese self-sufficiency in wheat. In this study it is concluded that Japan will probably require between 53 million and 63 million bushels of wheat annually. This volume of wheat she is capable of producing; consequently, she is not likely to import much wheat for domestic use, excepting modest amounts of strong wheat. She may continue to import additional wheat to mill for export, provided she can hold the flour markets of China, Manchukuo, and other eastern markets. The more basic question that is raised in this particular study is that of possible integration of commercial policy on the part of Japan. Japan appears to be, like the United States, attempting to ride two horses at the same time. That is, she is trying to develop a constantly broadening export market for manufactured goods and at the same time to make her production of agricultural raw materials self-sufficient. Up to the present time, Japan has been a net importing country, and consequently some curtailment of agricultural imports is permissible without interference with her export trade. On the other hand, any material increase in exports will require a maintenance or even increase in her imports in order to balance trade. The question must fairly be faced as to whether such imports will be forthcoming when Japan is self-sufficient in foodstuffs. Perhaps England faced this problem more realistically and fairly when she repealed the Corn Laws in order to permit the development of manufacturing for export.

Bulletin Number 8 discusses the production of flour in the United States from 1899 to 1935. Several important contributions are made. In the first place, it is interesting to note that the total production in 1933 and 1935 was approximately the same as in 1899. From the latter date, production increased to a maximum in 1919 when it was about 30 per cent higher than in 1899. Following the War, there was an abrupt drop of some 20 million barrels a year. This was followed by a few years of increase, reaching a new peak in 1929, some 18 per cent above the 1899 figure. During the depression, milling fell off materially and remained approximately stationary from 1933 to 1935. In the second place, it is interesting to note the change in proportion of milling done in mills of different size. In 1899, approximately 40 per cent of the total flour output came from large mills. This increased to 80 per cent in 1929 and has remained at approximately that point during the depression. The inquiry may, perhaps, be raised as to whether any further movement towards large mills will take place. This is perhaps a good illustration of the practical limits in the advantages arising from large-scale production. One wonders whether in most industries there are not opportunities for organizing production in plants of very different sizes with approximately the same cost. In the third place, it is pointed out that there are some important geographical differences in the proportion of large and small mills. In Minne-

sota and New York, particularly, the large mills dominate the industry. In the Kansas City area this is less distinctly true. Moreover, throughout the soft wheat districts there is a larger proportion of small mills than in the hard wheat milling districts. In a few of the soft wheat states, more than 50 per cent of the output still came from small mills in 1931.

In Bulletin Number 10, there are presented a great many new data concerning world wheat utilization over a long period of years, beginning with 1885. Both total use and per capita consumption are discussed in detail. It is particularly interesting that the United States is the only section of the world included in the study which did not show a continuous upward trend in per capita consumption up to the time of the World War. In contrast, there is no part of the world that has shown a per capita increase in any regular or continuous way since the War. Further, it is interesting to note that per capita consumption in the United States was distinctly higher than in other parts of the world until about 1905, at which time the consumption of western Europe and of the other larger exporting countries approximately equalled that of the United States. Since the War, per capita consumption has been definitely lower in the United States than either in western Europe or in the other principal exporting countries. This is associated, perhaps, with the increasing general standard of living in the United States and also with the increase in sedentary occupations.

There remains for mention only Bulletin Number 6, which is entirely different in character from the others included in this review. This bulletin deals with the stale bread problem in the United States. It starts with a brief consideration of the economic and social questions involved, but it deals primarily with the chemical and technical considerations. It is pointed out that the problem arises as a natural accompaniment of large-scale bakeries with distribution of bread from a single plant throughout an extended geographical area. Unless the waste due to staleness is minimized, it is likely to more than offset any advantages that attach to large-scale baking operations. The technical suggestions made in this study should prove of real value to the industry as well as to consumers through the reduction of the conditions that produce unusable, stale bakery products.

All these studies appear to be carried out with the usual thoroughness of the Food Research Institute. The series is rapidly giving us the most complete picture that is available of any single industry or series of related industries. Similar detailed information regarding other industries would be of great value. Although the general excellency of the wheat studies is high, still I cannot refrain from one broad criticism. It seems to me that many of the graphs that are used miss the full possibility for usefulness. Some of them are too complicated to be easily interpreted, and others are either misleading or fail to fully illustrate the point at hand. For example, Figures 1, 2, and 3 in Bulletin Number 7 on the Canadian wheat stabilization operations are, it seems to me, much more complicated than necessary and very difficult of actual visual comparison. The attempt is made in these figures to illustrate the effect of wheat pool policies on Winnipeg and Liverpool prices.

If the data could have been broken down into three or four separate graphs, it seems to me that the desirable comparisons would have been clear, whereas in the present form, it takes the proverbial Philadelphia lawyer to discover the comparison. As a second illustration, Figure 6 in Bulletin Number 10, on World wheat utilization, might well have been produced on a vertical log scale. This would have made possible visual comparisons of the rate of increase in utilization in the various parts of the world. Such a comparison is impossible from the graph as it stands, and yet that seems to be the main purpose for a presentation of the data in graphic form. Other illustrations of both of these two types of shortcomings could easily be mentioned.

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University of Minnesota

*A Handbook of Social Statistics of New Haven, Connecticut*, Yale University, Institute of Human Relations. New Haven: Yale University Press (Photoprint). 1936. Compiled by Thelma A. Dreis. xiii, 146 pp. \$2.50.

This excellent handbook represents for New Haven the same kind of systematized and basic information by wards that has in recent years been compiled for a large number of cities by census tracts. There are also some special features. It contains the usual analysis of population composition, economic and social status, and vital statistics drawn from the Census figures and state registrations. These are depicted on maps and in tables. In addition there are analyses of (1) professional leadership by wards, data for which has been drawn from *Who's Who* and various local directories; (2) juvenile delinquency distribution; (3) unemployment relief; (4) an interesting study of population mobility on the basis of applications and removal orders for gas meters; and (5) a sample study of about one-twentieth of all families with respect to (a) crowding, (b) size of family by nationality of head, (c) types of families (six-fold classification on the basis of composition), (d) income, (e) education, (f) religious preference, (g) unemployment, and (h) families known to relief agencies. The sample study, which yielded much information not available except through interviews, was selected by taking one in every twenty families from the gas company's residence files, supplemented by families in apartment houses. The full procedure is not described, but there are good reasons for regarding it as reliable. The handbook will be invaluable to local business administrators, government officials, and social workers. It is of more than local importance in its contribution to the growing body of information on the ecology of cities and in some of its methodological suggestions. It is excellent for its brevity, clearness, and total absence of "padding" with trivial "case" material, irrelevant history, and elaboration of the obvious. A street address index adds greatly to the practical usefulness of the handbook to future studies.

GEORGE A. LUNDBERG

Bennington College

- I. *Handbook for the Collection and Tabulation of Statistical Information about Children in Foster Care by the New York State Department of Social Welfare*: Presented by the Division of Research, Division of Child Welfare and the Division of State Institutions, 133 pp.
- II. *Handbook for the Collection and Tabulation of Statistical Information from Private Institutions for the Care of the Aged in the State of New York*: Presented by the Division of Medical Care, New York Department of Social Welfare, 56 pp.
- III. *Handbook for Statistics of Mothers' Allowances*: Prepared by the Division of Research and the Division of Child Welfare, 24 pp. State of New York, Department of Social Welfare. Albany: J. B. Lyon Company, Printers. 1935.

Progress in reporting statistical data pertaining to social work was given a strong impetus when a demonstration project "for the development of comprehensive statistics of welfare administration" was undertaken by the New York State Department of Social Welfare. Clothed with the legal right to demand definite information on the operation of all agencies falling within their jurisdiction, the State Departments of Social Welfare are in a more fortunate position in their attempts to standardize comprehensive reporting procedures than are the "appealers and persuaders" of the Children's Bureau, private foundations, or national associations.

Cognizant of this fact the Division of Research of the New York State Department of Social Welfare, with the financial assistance of the Spelman Fund of New York and the cooperation of an advisory committee on research headed by Ralph G. Hurlin, carried out an extensive three-year program in connection with the demonstration project. As a part of this project the Department of Social Welfare published a series of handbooks for collection and tabulation of statistical data in the various fields of social work. The three brochures that are subjects of this review are a part of this series.

The series of handbooks is of interest primarily to persons engaged in field work related to the registration of social statistics. The sets of forms suggested in the handbook for recording of data contain several additions and slight deviations from the forms used by the Children's Bureau, but instructions for filling out these forms are more detailed and more carefully worded. The first two handbooks give also an outline of a set of tables to be prepared for a comprehensive analysis of the selected data.

The implied appeal of this series is by far more significant than its particular contents. It is an appeal to the welfare departments of other states to profit by their strategic position and attempt on a statewide scale to standardize reporting procedures in social welfare work. The New York State Department of Social Welfare blazed the way. Will welfare departments of other states follow the lead?

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